INSTRUCTION BOOK

for

OPERATION AND MAINTENANCE

of

MN-26 SERIES MANUAL RADIO COMPASSES

Types
MN-26A
MN-26C
MN-26CA
MN-26M
MN-26W
MN-26X
MN-26Y

BENDIX RADIO

BENDIX RADIO DIVISION
BENDIX AVIATION CORPORATION
Baltimore, Maryland
U. S. A.

I.B. 472

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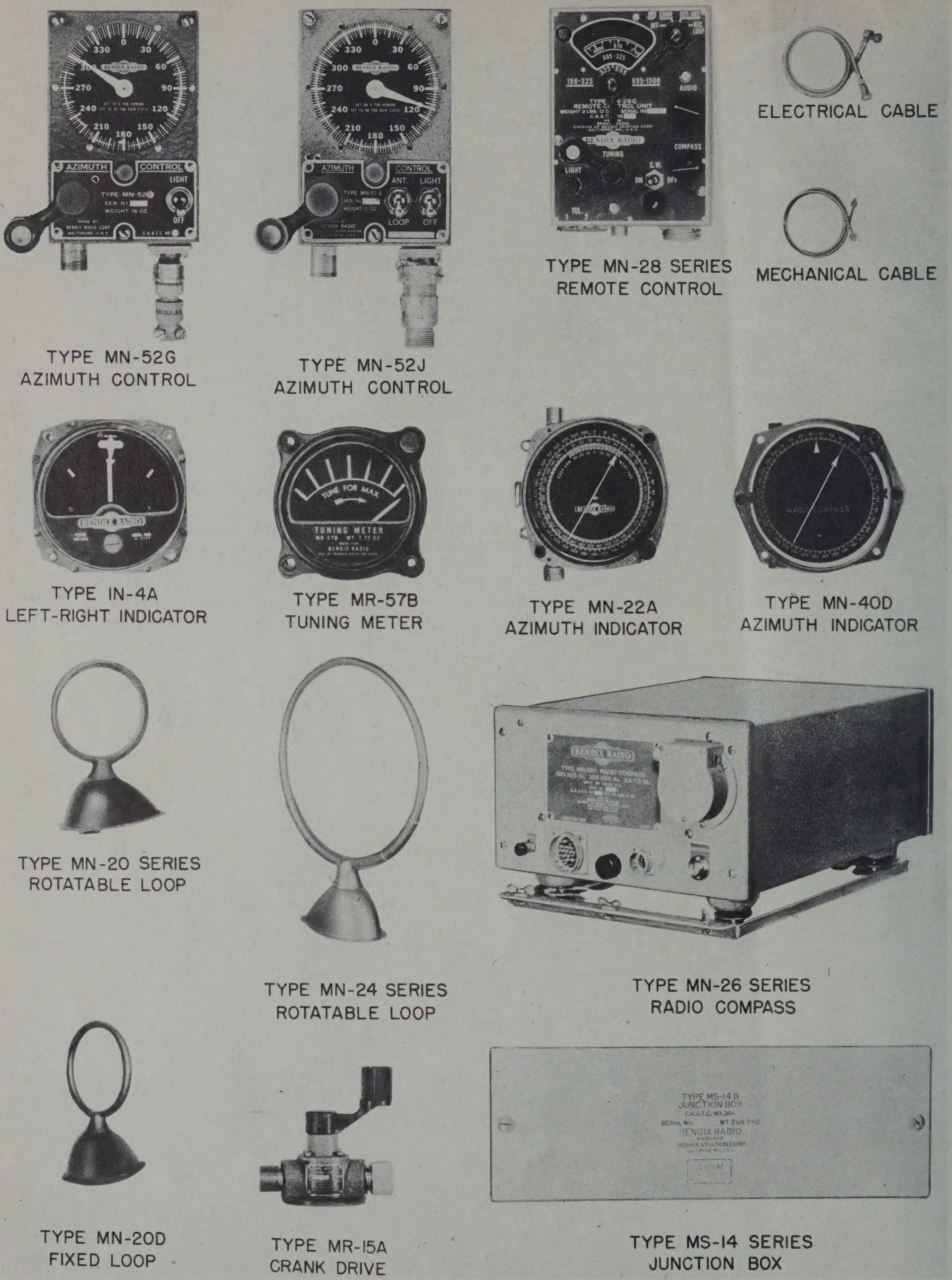


FIGURE 1 — MN-26 RADIO COMPASS EQUIPMENT, COMPONENTS

SECTION I

GENERAL DESCRIPTION

1. INTRODUCTION.

The various Models of the MN-26 Radio Compass equipments described in this instruction book are similar except in frequency range, output impedance, and input voltage.

a. FUNCTION.—The Model MN-26 Radio Compass equipment is an aircraft navigational equipment which indicates the direction of any desired transmitting station and also functions as a general radio receiver. The radio compass equipment provides the following services:

(1) Visible indication, by means of a left-right indicator, of the general direction from which the received signal is transmitted.

(2) Radio reception using a non-directional antenna.

(3) Radio reception using a loop antenna while flying through areas of rain and snow static.

(4) Visible indication of relative bearing between the aircraft and the transmitting station by means of an azimuth dial.

b. FREQUENCY.—Type MN-26 Radio Compass operates on three bands, covering the following frequency ranges:

Type Number	*Frequency Range*		
	Band I	*Band II*	*Band III*
MN-26A	150–325 kcs	325–695 kcs	695–1500 kcs
MN-26C	150–325 kcs	325–695 kcs	695–1500 kcs
MN-26CA	150–325 kcs	325–695 kcs	695–1500 kcs
MN-26M	200–410 kcs	410–850 kcs	3.4–7.0 mcs*
MN-26W	200–410 kcs	410–850 kcs	850–1750 kcs
MN-26X	200–410 kcs	410–850 kcs	850–1750 kcs
MN-26Y	150–325 kcs	325–695 kcs	3.4–7.0 mcs*

* No compass operation provision on Band III.

c. CONTROL.—Tuning is manually controlled from a remote control unit which may be mounted within easy reach of the operator. The bands are electrically selected by a control at this remote point.

d. POWER REQUIREMENTS.—The equipment is normally supplied to operate from the primary power source, indicated in the table below, but may be converted to operate on 14 or 28 volts by simple wiring changes as described in section VI, paragraphs, 31 *a* and 31 *b*.

(1) PRIMARY INPUT POWER REQUIREMENT OF TYPE MN-26 RADIO COMPASS.

Radio Compass Type Number	*Operating Voltage*	*Current Consumption*	
		Normal	*When Selecting Frequency Bands*
MN-26A	14	5.5	8.00
MN-26C	28	3.0	4.25
MN-26CA	28*	3.0	4.25
MN-26M	28	3.0	4.25
MN-26W	14	5.5	8.00
MN-26X	28	3.0	4.25
MN-26Y	28	3.0	4.25

* Type MN-26CA Radio Compass is designed for marine service and the positive input-brush (LV+) is connected to ground in place of the negative input-brush (LV−) as in the other models.

2. EQUIPMENT REQUIRED.

Many arrangements and combinations of Model MN-26 Radio Compass equipment are possible and no attempt is made in this book to describe them. A typical arrangement is shown in figures 30 and 79, but the actual combination and interconnections will depend upon the requirements of installation. The following tables list the minimum requirements:

a. INSTALLATION REQUIREMENTS.

Frequency Range	*Input Voltage**	*Output Impedance†*	*Size of Loop*	*Components Required*																			
				MN-26A	*MN-26C or MN-26CA*	*MN-26M*	*MN-26W*	*MN-26X*	*MN-26Y*	*MN-28C*	*MN-28G*	*MN-28NA*	*MN-28X*	*MN-28Y*	*MN-20A‡ or MN-20C*	*MN-24A‡ or MN-24B*	*IN-4A§*	*MR-57A***	*MS-14††*	*MN-40D or MN-22A*	*MN-52G*	*MR-15A*	*Cables‡‡*
150–1500 kcs	14V	600Ω	9″	X						X					X		X	X	X	X		X	X
150–1500 kcs	14V	600Ω	18″	X						X						X	X	X	X	X		X	X
150–1500 kcs	14V	4000Ω	9″	X							X				X		X	X	X	X		X	X
150–1500 kcs	14V	4000Ω	18″	X							X					X	X	X	X	X		X	X

Frequency Range	*Input Volt-age**	*Output Imped-ance†*	*Size of Loop*	*Components Required*																			
				MN-26A	*MN-26C or MN-26CA*	*MN-26M*	*MN-26W*	*MN-26X*	*MN-26Y*	*MN-28C*	*MN-28G*	*MN-28NA*	*MN-28X*	*MN-28Y*	*MN-20A‡ or MN-20C*	*MN-24A‡ or MN-24B*	*IN-4A§*	*MR-57A***	*MS-14††*	*MN-40D or MN-22A*	*MN-52G*	*MR-15A*	*Cables‡‡*
150–1500 kcs	28V	600Ω	9″		X					X					X		X	X	X	X		X	X
150–1500 kcs	28V	600Ω	18″		X					X						X	X	X	X	X		X	X
150–1500 kcs	28V	4000Ω	9″		X						X				X		X	X	X	X		X	X
150–1500 kcs	28V	4000Ω	18″		X						X					X	X	X	X	X		X	X
200–1750 kcs	14V	600Ω	9″				X						X		X		X	X	X	X		X	X
200–1750 kcs	14V	600Ω	18″				X						X			X	X	X	X	X		X	X
200–1750 kcs	28V	600Ω	9″					X					X		X		X	X	X	X		X	X
200–1750 kcs	28V	600Ω	18″					X					X			X	X	X	X	X		X	X
150–695 kcs and 3.4–7.0 mcs	28V	600Ω	9″						X					X	X		X	X	X	X	X	X	X
150–695 kcs and 3.4–7.0 mcs	28V	600Ω	18″						X					X		X	X	X	X	X	X	X	X
200–850 kcs and 3.4–7.0 mcs	28V	600Ω	9″			X						X			X		X	X	X	X		X	X
200–850 kcs and 3.4–7.0 mcs	28V	600Ω	18″			X						X				X	X	X	X	X		X	X

* May be converted from 14 to 28 volt or from 28 to 14 volt operation by simple wiring changes.

† May be converted with simple wiring changes.

‡ Types MN-20A and MN-24A have right angle (90°) tachshaft fittings while types MN-20C and MN-24B have straight tachshaft fittings.

§ One or two left-right indicators may be used but when only one is required the meter load assembly AA18824-1 must be included in the installation.

** Use of tuning meter is optional.

†† The particular junction box type number (MS-14A, MS-14B or MS-14C) will depend upon the installation requirements.

‡‡ The number and types of cables will depend upon the installation requirements and may be either purchased or constructed.

b. COMPONENTS REQUIRED FOR EACH INSTALLATION (see figure 1).

Quantity	*Equipment*	*Weight (Lbs.)*
1*	Type MN-26* Radio Compass, complete with mounting base: the following tubes; 1-6L7, 2-6N7, 1-6B8, 2-6J5, 5-6K7, 1-6F6, and plugs as follows; 1-antenna plug, 1-electrical cable plug.	37.37
1*	Type MN-28* Remote Control, complete with mounting base, fuse, and electrical cable plug.	2.75
	Type MN-20A Rotatable Loop Unit, 9″ diameter, complete with right angle (90°) tachshaft fitting.	5.3
	or	
1	Type MN-20C Rotatable Loop Unit, 9″ diameter, complete with straight tachshaft fitting.	5.3
	or	
	Type MN-24A Rotatable Loop Unit, 18″ diameter, complete with right angle (90°) tachshaft fitting.	7.00
	or	

Quantity	*Equipment*	*Weight (Lbs.)*
1	Type MN-24B Rotatable Loop Unit, 18″ diameter, complete with straight tach-shaft fitting.	7.00
	or	
	Type MN-20D Fixed Homing Loop, 9″ dia.	4.2
1 or 2	Type IN-4A Left Right Indicator, complete with electrical cable plug, and meter load assembly AA18824-1.	1.75 each
1	Type MN-52G Azimuth Control	0.875
1 (optional)	Type MR-57A Tuning Meter.	0.69
1**	Type MS-14** Junction Box, location of cable entering holes as specified.	**
1	Type MN-40D Azimuth Indicator	2.1
	or	
	Type MN-22A Azimuth Indicator.	1.81
1	Type MR-15A Crank Drive (only for types MN-40D and MN-22A Azimuth Indicators).	.375

1 each of the following cables, lengths as specified (see section II, paragraphs 6 and 7 for ordering or constructional information).

Bendix Part No.	*Function*	*Weight (Lbs. per foot)*
AA15410-1	Mechanical connection from Loop to Indicator or Crank Drive.	
AA15410-1	Mechanical connection from Crank Drive to Indicator or Loop.	
AA15410-1	Mechanical connection from Compass to Remote Control Unit.	
AC55966-1 or AC55966-2 or AC55966-3	Loop transmission cable from Loop to Compass.	
AC58267-1 or AC58267-2 or AC58267-3 or AC58267-4	Electrical connections from Left-Right Indicator to Junction Box.	0.12 lb. per ft. plus 0.06 lb. 0.12 lb. per ft. plus 0.08 lb. 0.12 lb. per ft. plus 0.06 lb. 0.12 lb. per ft. plus 0.08 lb.
AC59728-1 or AC59728-2 or AC59728-3 or AC59728-4	Electrical connections from Compass to Junction Box.	0.3 lb. per ft. plus 0.16 lb. 0.3 lb. per ft. plus 0.23 lb. 0.3 lb. per ft. plus 0.16 lb. 0.3 lb. per ft. plus 0.23 lb.

Bendix Part No.	*Function*	*Weight (Lbs. per foot)*
AC59729-1 or AC59729-2 or AC59729-3 or AC59729-4	Electrical connections from Remote Control Unit to Junction Box.	0.25 lb. per ft. plus 0.13 lb. 0.25 lb. per ft. plus 0.07 lb. 0.25 lb. per ft. plus 0.13 lb. 0.25 lb. per ft. plus 0.07 lb.
AA26172-1	Dial light cable for Type MN-40D Azimuth Indicator or Type MN-22A Azimuth Indicator or Type MN-52G Azimuth Indicator to Junction Box.	

* While the particular compass type number will depend on the frequency range and input voltage desired, the remote control unit must be one which will match the desired compass. The correct remote control type numbers are listed in the following table.

** The particular junction box type number will depend upon the installation requirements. The following table gives information on the MS-14 types.

Radio Compass Type	*Remote Control, Type*	
	For Low Impedance Output	*For High Impedance Output*
MN-26A	MN-28C	MN-28G
MN-26C	MN-28C	MN-28G
MN-26CA	MN-28C	MN-28G
MN-26M	MN-28NA	
MN-26W	MN-28X	
MN-26Y	MN-28Y	

Junction Box, Type	*Number of Terminals*	*Weight (lbs.)*	*Overall Size*
MS-14A	14	1.38	$7\frac{7}{8}$ x $4\frac{57}{64}$ x $2\frac{1}{16}$
MS-14B	32	2.44	$14\frac{21}{32}$ x $4\frac{57}{64}$ x $2\frac{1}{16}$
MS-14C	64	3.50	$20\frac{13}{32}$ x $4\frac{57}{64}$ x $2\frac{1}{16}$

3. ADDITIONAL EQUIPMENT REQUIRED.

The following additional items must be provided by the customer in order to operate this equipment.

Quantity	*Description*
1	14- or 28-volt DC primary power source.
1	Suitable antenna system (see section II, paragraph 6*i*).
1 or 2	Headphones (MR-8E, 600-ohm for low impedance remote control unit, or MR-48A, 4000-ohm for high impedance remote control unit).

4. DESCRIPTION OF PRINCIPAL COMPONENTS.

a. TYPE MN-26 RADIO COMPASS.—The radio compass includes a cabinet, chassis, and mounting base. All connections are made to the front panel (see figure 2). The upper right corner of the front panel contains the gear box which receives the mechanical cable for tuning control at Type MN-28 Remote Control unit. Below the gear box is the ANTENNA receptacle and plug for electrical connection to the sense antenna. To the left of the ANTENNA receptacle is the LOOP receptacle for electrical connection to Type MN-20 or MN-24 Rotatable Loop. To the left of the LOOP receptacle is the chassis RELEASE control which secures the chassis to the cabinet. To the left of the chassis RELEASE control is the JUNCTION BOX receptacle for electrical connection through Type MS-14 Junction Box to the other components. To the left of the Junction Box Receptacle is the Ground Terminal for use in grounding chassis. The cabinet is secured to the mounting base with three wing-nut Dzus fasteners which provide for easy removal of the radio compass unit. The chassis contains the compass circuit elements, the superheterodyne receiver circuit elements, and the high voltage power supply.

Type MN-26 Radio Compass is a remotely controlled, 12-tube superheterodyne with an intermediate frequency of 112.5 kilocycles. The frequency range of the equipment is covered in three bands as follows:

Type Number	Frequency Range			Compass Operation
	Band I	Band II	Band III	
MN-26A	150–325 kcs	325–695 kcs	695–1500 kcs	Bands I, II, & III
MN-26C	150–325 kcs	325–695 kcs	695–1500 kcs	Bands I, II, & III
MN-26CA	150–325 kcs	325–695 kcs	695–1500 kcs	Bands I, II, & III
MN-26M	200–410 kcs	410–850 kcs	3.4–7.0 mcs	Bands I, & II
MN-26W	200–410 kcs	410–850 kcs	850–1750 kcs	Bands I, II, & III
MN-26X	200–410 kcs	410–850 kcs	850–1750 kcs	Bands I, II, & III
MN-26Y	150–325 kcs	325–695 kcs	3.4–7.0 mcs	Bands I, & II

The aircraft storage batteries supply primary power and a dynamotor and filter circuit within the compass supplies the high voltage.

The radio compass is supplied with a complete set of vacuum tubes, the type and function of which are as follows:

Quantity	Vacuum Tube Type Number	Reference Number	Function of Vacuum Tube
5	6K7	V1	Loop Amplifier
		V4	1st R-F Amplifier
		V5	2nd R-F Amplifier
		V8	I-F Amplifier
		V12	Compass Amplifier
2	6N7	V2	Audio Oscillator
		V3	Modulator
2	6J5	V7	Heterodyne Oscillator
		V9	C W Oscillator
1	6L7	V6	1st Detector
1	6B8	V10	2nd Detector
1	6F6	V11	Audio Amplifier

b. TYPE MN-28 REMOTE CONTROL.—The remote control unit contains all controls for operation

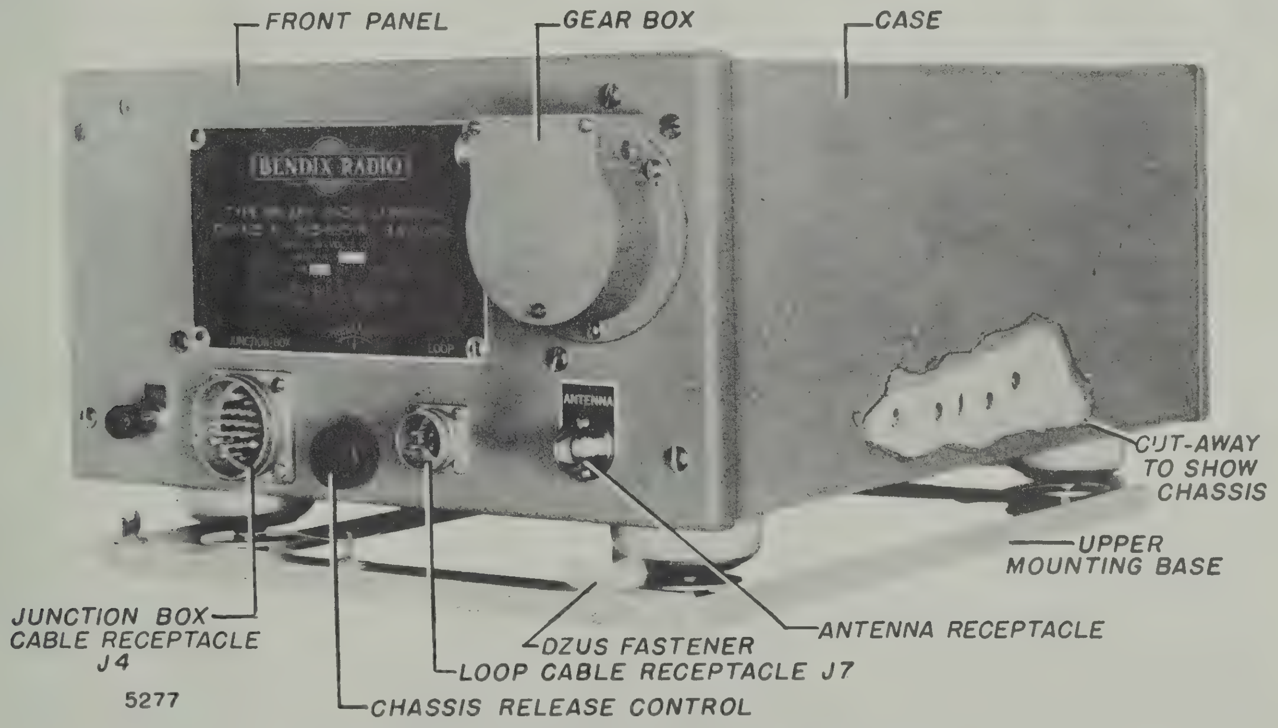


FIGURE 2 — TYPE MN-26 RADIO COMPASS, FRONT VIEW

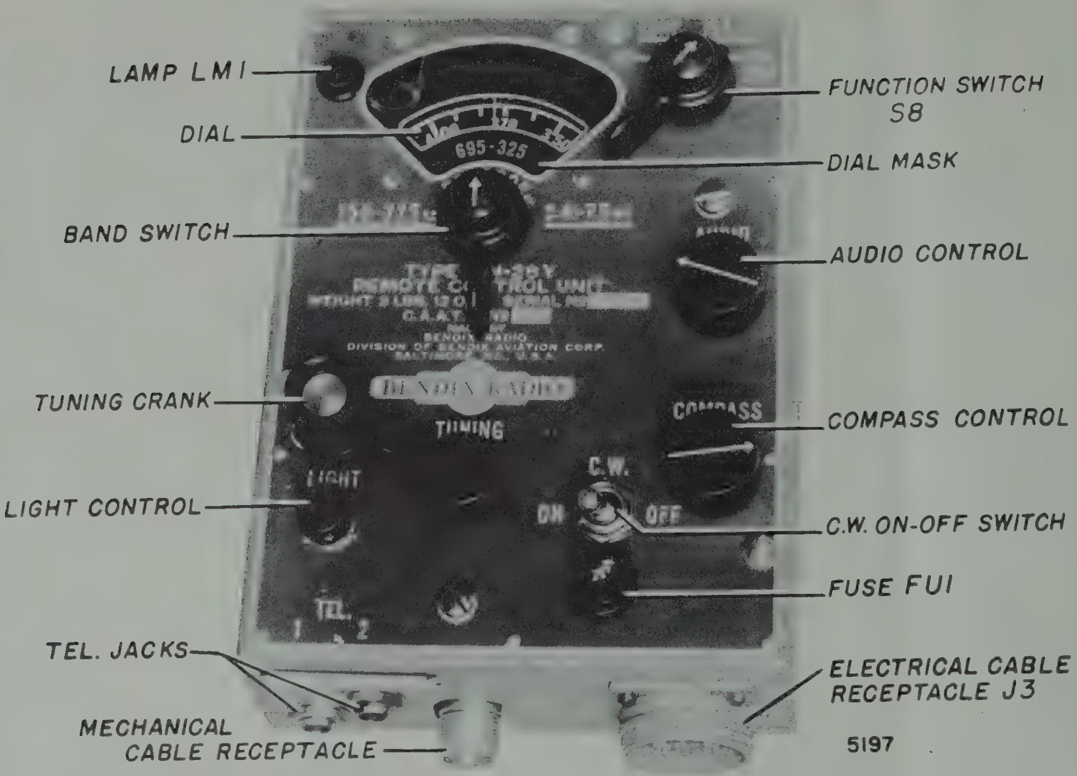


FIGURE 3 — TYPE MN-28 REMOTE CONTROL, FRONT VIEW

of the radio compass equipment (see figure 3). Control of electrical and mechanical function is effected through the electrical cable receptacle for connection to Type MS-14 Junction Box, the mechanical cable receptacle for tuning of Type MN-26 Radio Compass, and the two TEL. jack for connection to the headphones. The dial indicates the frequency at which the receiver is operating and is lighted by the Lamp LM-1. The controls are as follows (see figure 3);

Tuning crank; The TUNING crank operates the dial and is connected through a train of gears and the mechanical cable to the tuning capacitor of the radio compass unit. The gear ratio between the tuning crank and the variable capacitor is 120 to 1. The dial is calibrated as follows:

Type MN-28C and MN-28G
- Band I calibrated every 5 kcs from 150 to 325 kcs
- Band II calibrated every 10 kcs from 325 to 695 kcs
- Band III calibrated every 10 kcs from 695 to 1500 kcs

Type MN-28NA
- Band I calibrated every 5 kcs from 200 to 410 kcs
- Band II calibrated every 10 kcs from 410 to 850 kcs
- Band III calibrated every .05 mcs from 3.4 to 7.0 mcs

Type MN-28X
- Band I calibrated every 5 kcs from 200 to 410 kcs
- Band II calibrated every 10 kcs from 410 to 850 kcs
- Band III calibrated every 10 kcs from 850 to 1750 kcs

Type MN-28Y
- Band I calibrated every 5 kcs from 150 to 325 kcs
- Band II calibrated every 10 kcs from 325 to 695 kcs
- Band III calibrated every .05 mcs from 3.4 to 7.0 mcs

Band switch; The frequency-band selector switch located below the dial, energizes the band switching motor in the radio compass and thus is capable of selecting any of the three bands. The mask, attached to the switch shaft, permits viewing only that part of the tuning dial associated with the bands elected. The band-range in use is marked on the mask.

Function switch; A four position switch S8 selects the desired operating function. In the OFF position, no current is drawn from the low voltage power supply. In the COMP. position, the circuit elements are ar-

ranged to provide compass operation. In the REC. ANT. position, the equipment functions as a communication receiver connected to a non-directional vertical antenna. In the REC. LOOP position, the equipment functions as a communication receiver connected to the directional loop antenna.

Light control; The control knob designated LIGHT regulates the brilliancy of the Lamp LM-1 which illuminates the calibrated dial.

Audio control; The control knob designated AUDIO regulates the level (volume) of the audio signal in the headsets.

Compass control; The control knob designated COMPASS operates a potentiometer R3 to regulate the extent of pointer deflection of Type IN-4A Left-Right Indicator.

Threshold sensitivity control; A control R2 (not shown in figure 1) is mounted inside the remote control unit case. This control is adjusted at the time of installation (COMPass operation only) to limit the gain of the radio frequency amplifiers to such an extent that erratic fluctuations of the left-right indicator due to noise is eliminated. Instructions for adjusting this control is given in section II, paragraph 11.

c. TYPES MN-20, MN-24 ROTATABLE LOOPS AND MN-20D FIXED LOOP (see figures 4 and 1).—The loop consists of a coil of wire with a center tap, enclosed in an electrostatic shield. The loop is permanently fastened into the mounting base. All connections from the loop coil, in the case of the rotatable loops, are made through slip rings to brushes which are connected to the loop transmission cable receptacle. Rotation of the loop is accomplished by means of the associated azimuth control, flexible tuning shaft, and fittings which drive the loop gears that are located in the mounting base.

In the case of the Type MN-20D Fixed loop there is only a fixed wire connection to the loop transmission cable receptacle, there being no necessity for slip ring connections or a tuning cable.

The following table lists the differences between the Types MN-20A, MN-20C, MN-20D.

Loop Type Number	*Diameter of Loop*	*Type of Fitting*
MN-20A	9″	Right Angle
MN-20C	9″	Straight
MN-24A	18″	Right angle
MN-24B	18″	Straight
MN-20D	18″	None

d. TYPE MN-22A AZIMUTH INDICATOR (see figure 5).—Essentially the Type MN-22A Azimuth Indicator consists of a double-ended tachshaft drive to which is connected, through an appropriate gear and cam drive, a pointer that moves in the horizontal plane against the indicator dials. It is designed for use with standard aircraft tachometer shafts.

A circular cam is connected to the internal gearing. This cam is scribed with nine circles and twenty-four radial lines corresponding to degrees correction and degrees azimuth rotation respectively. The cam may be cut to any required shape to meet the particular installation and can accommodate a maximum error of plus or minus 20 degrees. As supplied the cam introduces no correction and can, if no error correction is required, be used without further adjustment. Shap-

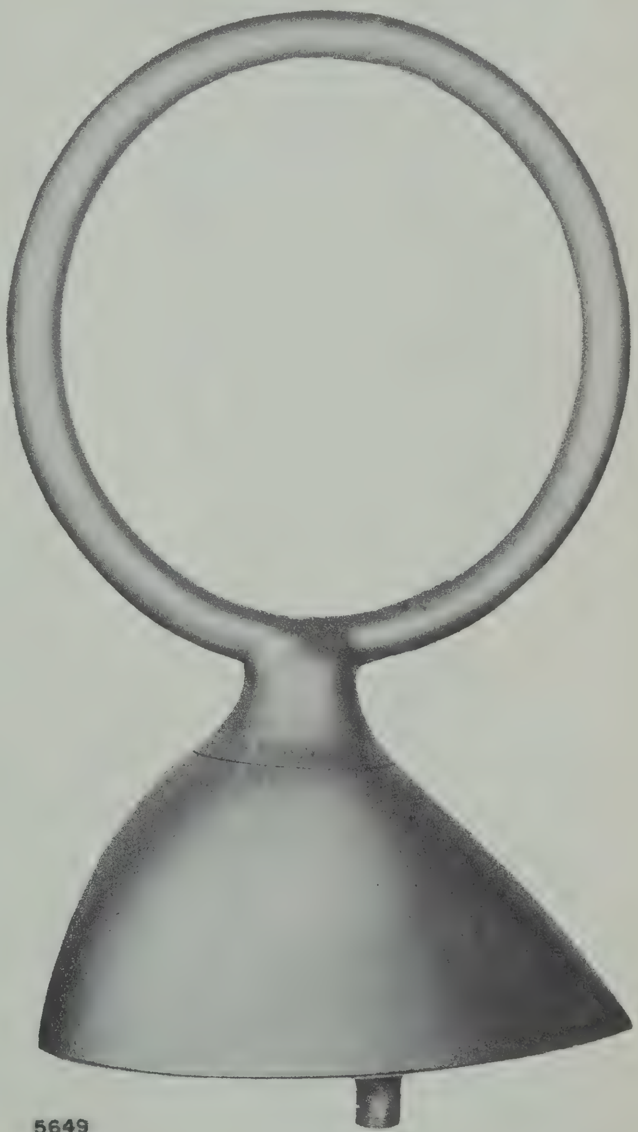


FIGURE 4 — TYPE MN-20 ROTATABLE LOOP

FIGURE 5 — TYPE MN-22A AZIMUTH INDICATOR

ing of the cam for error adjustment is described in section II, paragraph 13 *b*.

Two instrument lamps provide ample illumination.

The Type MN-22A Azimuth Indicator provides means for obtaining loop rotation and bearings (indications of loop settings corrected for quadrantal error) as follows:

(1) Bearings relative to ships heading are read on the outer fixed dial.

(2) Magnetic bearings are read under the pointer on the inner movable dial, after the number on this dial, which corresponds to the airplane's magnetic course, has been set at the zero mark on the fixed dials.

FIGURE 6 — TYPE MN-40D AZIMUTH INDICATOR

(3) True bearings are read under the pointer on the movable dial after the number on this dial, which corresponds to the airplane's magnetic course, has been set opposite the east or west compass variation shown on the inner fixed dial.

(4) Reciprocal bearings can be read at the opposite end of the pointer.

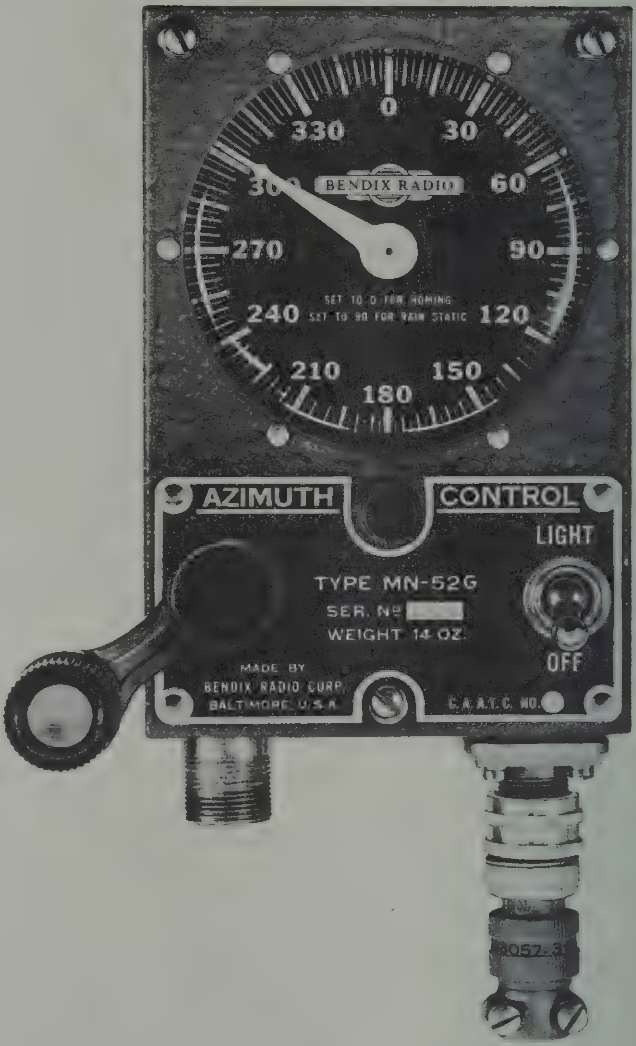


FIGURE 7 — TYPE MN-52G AZIMUTH CONTROL

e. TYPE MN-40D AZIMUTH INDICATOR (see figure 6).—Essentially, Type MN-40D Azimuth Indicator consists of a double-ended tuning shaft drive to which is connected, through an appropriate gear- and cam-drive, a pointer which moves over the azimuth scale, two 3-volt lamps and an internal dropping resistor (provided to permit operation on 12-volts).

The cam strip is located in the cam housing assembly and is provided with an adjusting screw (through the

cam housing assembly) at each 15 degrees around its periphery. The compensator which is controlled by this cam strip automatically applies the aircraft error correction to the indicator pointer. The scale which is visible through the small opening in the lower center of the indicator face is used as a reference scale when the aircraft error compensators are being adjusted.

The heading of the aircraft relative to magnetic North, and any necessary East or West variation correction is applied by moving the azimuth scale the proper number of degrees relative to the fixed index mark by means of the variation knob.

Quadrantal error correction is accomplished by cutting the cam on Type MN-22A Azimuth Control, but is corrected by adjusting the cam screws on Type MN-40D Azimuth Indicator. As supplied the cam adjustment screws introduce no correction. Adjustment of the cam is described in section II, paragraph 13 *a*.

f. TYPE MN-52G AZIMUTH CONTROL consists of a crank-operated azimuth dial pointer operated through a mitre and worm gear assembly, which in turn through appropriate gearing and by means of a tachshaft assembly rotates the compass loop. A dial light is provided, which may be switched on or off by means of a toggle switch. Turning the crank rotates the azimuth pointer and compass loop simultaneously, and when the instrument is properly installed, the dial reading corresponds to the loop heading.

No provision is made on Type MN-52G Azimuth Control for automatically incorporating the calibrated correction error. This will be further discussed under section *i*.

This description is applicable to the TYPE MN-52J AZIMUTH CONTROL with the exception that the Type MN-52J Azimuth Control is provided with an "off-zero" warning light and a toggle switch for controlling same.

The warning light or lights provide visual warning indication of off-zero loop settings when a Type MN-52J Azimuth Control is used. The light is turned on or off by the cam operated switch located in the Type MN-52J Azimuth Control Unit. The warning light is *on* when the pointer is *not* on zero. A voltage dropping resistor is supplied complete with mounting hardware for installation in the junction box. It will be necessary to use this resistor on 28-volt installations.

The warning light circuit is switched on when the toggle switch is in the LOOP position and off when in the ANT. position.

The warning light may be mounted in any location that is constantly in the pilot's view. No warning light is used with the MN-22A or the MN-40D Azimuth Indicators.

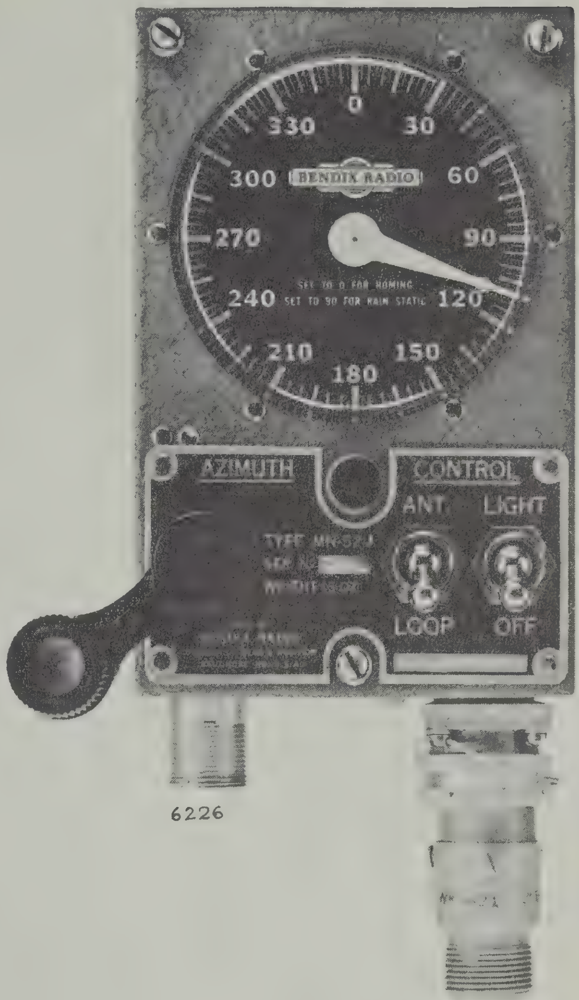


FIGURE 8 — TYPE MN-52J AZIMUTH CONTROL

g. TYPE IN-4A LEFT-RIGHT INDICATOR (see figure 9).—The left-right indicator shows the general direction of the transmitter and is used for homing. The on-course mark is a small airplane. The pointer and dial markings are coated with luminous paint. The movement is of the stationary iron-core dynamometer type. The field coil is center-tapped and serves as the plate inductance for the audio oscillator, being resonated by a capacitor which is mounted inside the case.

When only one left-right indicator is used, it is necessary to connect the meter field load assembly AA18824-1 across the indicator field.

h. TYPE MS-14 JUNCTION BOX (see figure 10).—All connections between the various components are to be made in the junction box. The Type MS-14 Junction Box is provided with #8-32 screw terminals upon which connections are made.

Figure 9 — Type IN-4A Left-Right Indicator

The size of the junction box depends upon the installation requirements. The Type MS-14A has 14 terminals, the Type MS-14B has 32 terminals and the Type MS-14C has 46 terminals.

i. TYPE MR-15A CRANK DRIVE (see figure 11).—The Type MR-15A Crank Drive when coupled by means of the mechanical cable to the azimuth indicator, is used to rotate the indicator and the loop. The mechanical cable may be coupled to either of two pinions depending upon the desired direction of rotation in relationship to loop and indicator rotation.

The unused pinion is protected by a cap which is equivalent to the coupling nut of the mechanical cable.

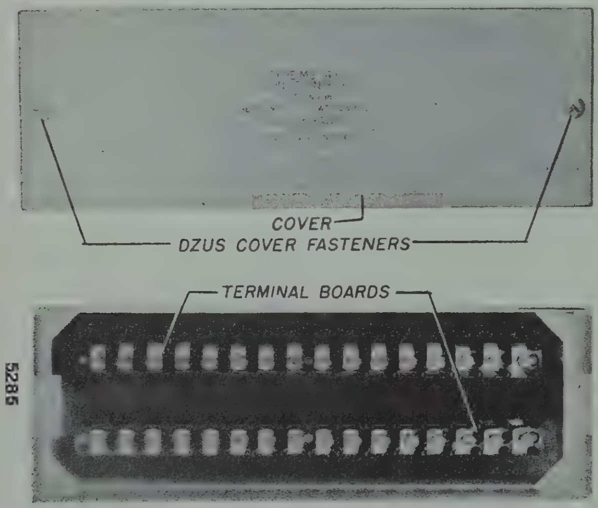


Figure 10 — Type MS-14 Junction Box

The TYPE MR-15A CRANK DRIVE is not used when the TYPE MN-52G AZIMUTH CONTROL or the TYPE MN-52J is used because loop and azimuth pointer driving mechanism (crank-operated) is provided as a built-in part of this unit.

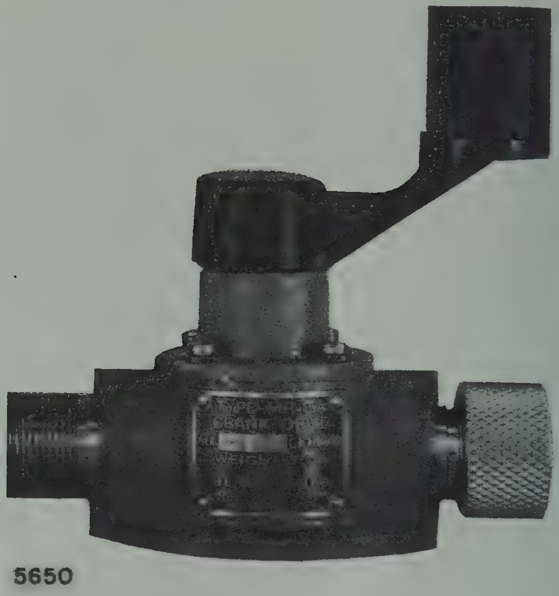


Figure 11 — Type MR-15A Crank Drive

Figure 12 — Type MR-57B Tuning Meter

j. TYPE MR-57A TUNING METER (see figure 12).—The Type MR-57A Tuning Meter is an aircraft type 0–5 milliammeter with a suppressed-zero movement so arranged that the pointer will leave the right hand zero stop with 2 milliamperes and will read full scale at the left stop with 5 milliamperes.

When no tuning meter is used with the equipment. terminal 18 of receptacle J4 must be grounded. If the tuning meter is used, the positive terminal of the meter is connected to this terminal 18 and the negative terminal is grounded. A 500-ohm resistor across the meter terminals will prevent the receiver from becoming inoperative in event of meter coil failure.

k. CABLES.

(1) MECHANICAL CABLES.—The mechanical cables are Bendix part number AA15410-1 and one each is required for the following mechanical connections:

(*a*) From Type MN-28 Remote Control to Type MN-26 Radio Compass for tuning (selection of operating frequency).

(*b*) From Type MR-15A Crank Drive to Type MN-40D Azimuth Indicator or Type MN-22A Azimuth Indicator.

(*c*) From the indicator to Type MN-20 Rotatable Loop or Type MN-24 Rotatable Loop for rotation of the loop.

(d) From TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL to loop rotating mechanism.

When ordering mechanical cables, the length must be specified. Twelve inches is the shortest mechanical cable available. Figure 27 illustrates the construction and alteration of the length is described in section II, paragraph 6 *l*.

(2) ELECTRICAL CABLES.—A choice of several combinations of cable and plugs are available for each cable required. The individual installation will determine the requirements. The following table lists the available combinations for each cable (see figures 29 and 30).

Function	*Bendix Cable Part No.*	*Termination*	
		Equipment End	*Junction Box End*
Type IN-4A Left-Right Indicator to Junction Box	AC58267-1	6-contact Straight Plug	Clamp ferrule
	AC58267-2	6-contact Right Angle Plug	Clamp ferrule
	AC58267-3	6-contact Straight Plug	Coupling nut
	AC58267-4	6-contact Right Angle Plug	Coupling nut
Azimuth Indicator to Junction Box	AA26172-1	1-contact Plug	Rubber Grommet
Remote Control Unit to Junction Box	AC59729-1	16-contact Straight Plug	Clamp ferrule
	AC59729-2	16-contact Right Angle Plug	Clamp ferrule
	AC59729-3	16-contact Straight Plug	Coupling nut
	AC59729-4	16-contact Right Angle Plug	Coupling nut
Radio Compass to Junction Box	AC59728-1	23-contact Straight Plug	Clamp ferrule
	AC59728-2	23-contact Right Angle Plug	Clamp ferrule
	AC59728-3	23-contact Straight Plug	Coupling nut
	AC59728-4	23-contact Right Angle Plug	Coupling nut
Rotatable Loop To Radio Compass	AC55966-1	6-contact Straight Plug	6-contact Right Angle Plug
	AC55966-2	6-contact Straight Plug	6-contact Straight Plug
	AC55966-3	6-contact Right Angle Plug	6-contact Right Angle Plug

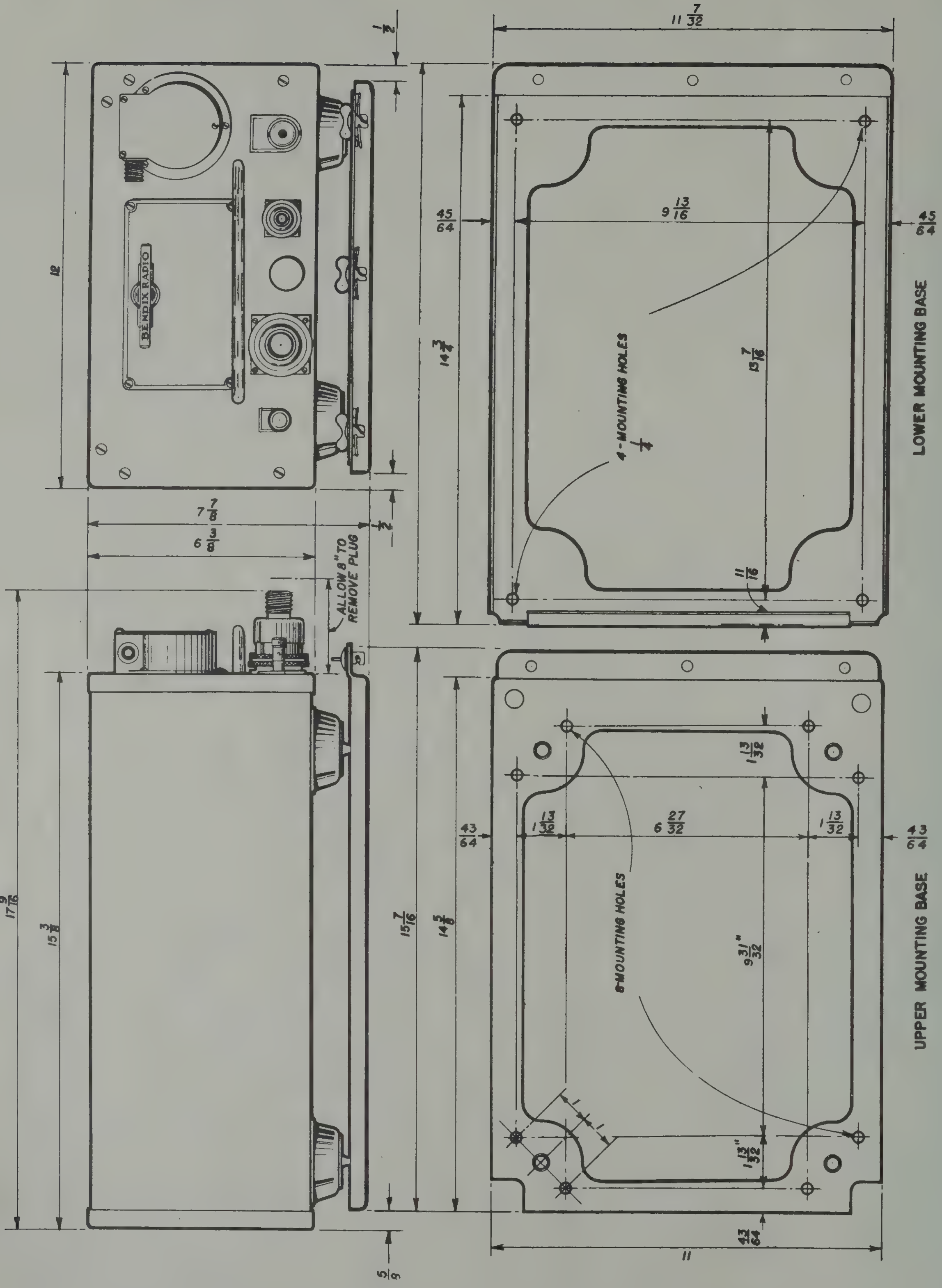


FIGURE 13 — TYPE MN-26 RADIO COMPASS, OUTLINE AND MOUNTING DIMENSIONS

SECTION II

INSTALLATION AND ADJUSTMENT

5. PRELIMINARY INSPECTION.

Prior to installation of the components a thorough visual and, if possible, electrical inspection of all parts should be made in accordance with the procedure described in section V, paragraph 28.

a. TESTS BEFORE INSTALLATION IN AIRCRAFT.—Considerable time and trouble will be saved if the components of radio compass equipment to be installed in aircraft are interconnected as shown in figure 30, and tested before installation. If a standard transmission line test set-up is available, the performance of the equipment should be measured in accordance with section V, paragraph 28. If the above test set-up is not available, the components should be properly interconnected and tested as follows: Tune in several radio stations in each band. On each station operate the equipment on the COMP., REC.ANT., and REC.LOOP positions. When operating the equipment on COMP., swing the loop to the right and left and note the degrees of loop rotation required to produce full scale indicator deflection with the COMPASS control set at maximum. This should be approximately 5 to 6 degrees, dependent on the input signal strength. Note the on-course and reciprocal bearings. From a knowledge of the distance, power, and direction of the station a rough check may be obtained of the performance of the equipment. These tests should be made in a frame test shack in an isolated spot free from electrical interference and at least 2000 feet distant from large electrically conductive objects such as buildings, hills, power lines, railroads, etc. *Sensing or bearing accuracy checks can not be relied upon if made inside or close to buildings with metal structures or large electrically conductive objects unless radio compass bearings check actual geographical bearings.* The sensing of the radio compass should be such that the indicator pointer points to the station; that is, if the station is to the left of the perpendicular to the plane of the loop, the indicator should point left; if station is on the right, the indicator should point right. The following inspection should be made prior to installation:

(1) Check list of parts and see that all parts are in good condition.

(2) Insert all tubes in the radio compass unit, making sure that they are firmly seated in their respective sockets and that all grid clips and grid cap shields are pushed down tightly. The absence of grid camp shields in the RF circuits will introduce bearing errors.

(3) Check safety wiring of dynamotor. (Safety wiring used on older models—eliminated on newer ones.)

(4) Check all lamps and fuses.

(5) Check operation of tuning drives and all controls for freedom of operation.

(6) Allow the equipment to operate for at least one-half hour. Check operation of headset. Vibrate or jar the equipment. Any clicks or increase in noise will require a thorough investigation and removal of the cause. Improper soldering of wires to the plugs and noisy vacuum tubes are the usual source of trouble.

(7) If the equipment does not seem to be operating satisfactorily, the interconnecting leads and vacuum tubes should be rechecked and equipment known to be in operable condition substituted for the faulty component.

b. BONDING AND SHIELDING.—The ultimate sensitivity of any aircraft receiving installation is limited by the magnitude of the local electrical interference, rather than by the actual sensitivity of the receiver as measured in the laboratory. If reception of weak signals is desired, the aircraft, engine, charging generator, ignition system, and all electrical accessories must be completely bonded and shielded prior to installation of the equipment.

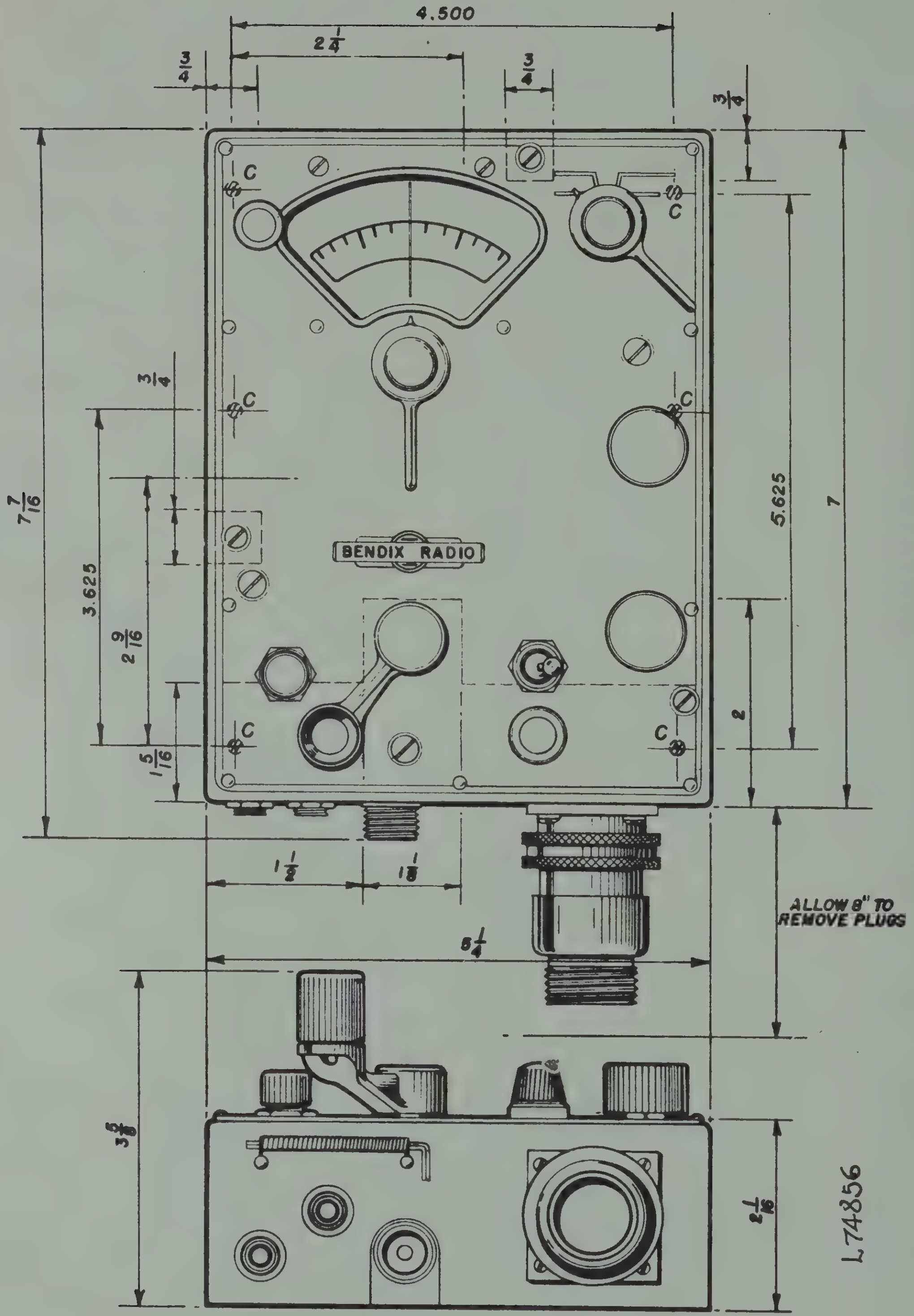
6. LOCATION AND MOUNTING OF EQUIPMENT

Figures 13 to 23 show the necessary dimensions for mounting of the components.

a. TYPE MN-26 RADIO COMPASS.—The mounting base of the radio compass must be firmly attached to a plane surface by six #10 screws, and should be so installed that sufficient clearance is allowed on all sides of the compass for free action of the shock absorbers and for removing the compass from the mounting base. See figure 11 for mounting dimensions.

b. TYPE MN-28 REMOTE CONTROL UNIT.—The remote control unit should be located where the panel will be easily visible and the controls accessible to the operator. Consideration must be given to providing clearance for connection of the mechanical and electrical cables. See figure 14 for mounting dimensions.

No mounting holes are provided in the base of the remote control unit since the requirements will vary with individual installations. The control box is secured to its mounting base by means of the three stainless steel fillister-head mounting screws located



NOTE:
ADDITIONAL MOUNTING HOLES MAY BE DRILLED OUTSIDE OF DOTTED AREA ONLY.
MOUNTING HOLES "C" = NO.12 DRILL

FIGURE 14 — TYPE MN-28 REMOTE CONTROL, OUTLINE AND MOUNTING DIMENSIONS

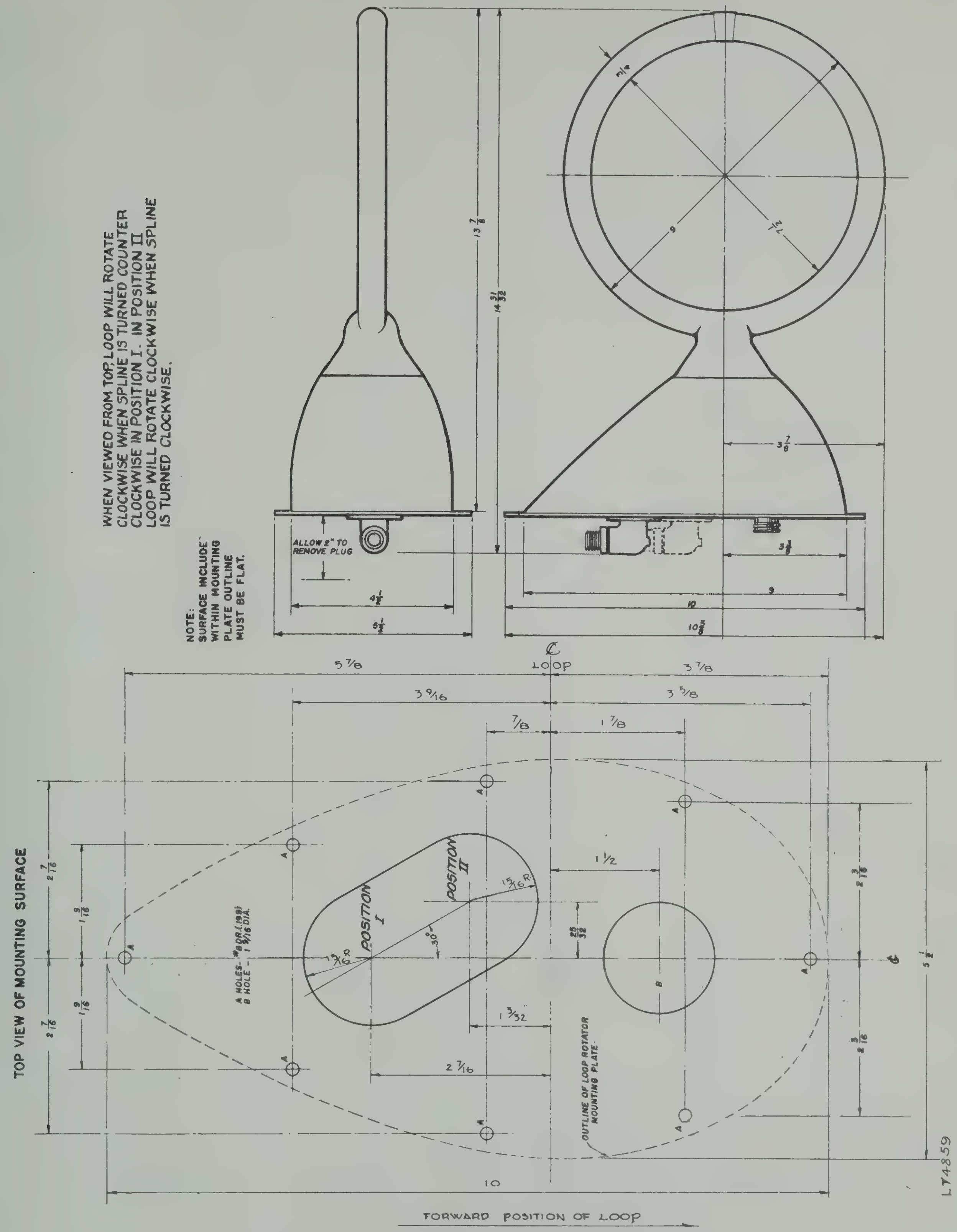


FIGURE 15 — TYPE MN-20 ROTATABLE LOOP, OUTLINE AND MOUNTING DIMENSIONS

on the front panel. These are captive-type screws and are loosened to remove the unit from its mounting base.

c. TYPE MN-20, TYPE MN-24 ROTATABLE LOOPS or the TYPE MN-20D FIXED LOOP.—The loop must be mounted within a 42 to 168-inch cable run of the compass unit, and should be as far removed as possible from antennas and interfering metal structures. The preferred locations are on the fore-and-aft center line of the ship, either above or below the fuselage, about where the wings are attached. The MN-20D Fixed Loop *must* be mounted on this fore-and-aft line and the plane of the loop must be at right angles to this fore-aft line, i.e., the center of this loop is on the fore-and-aft line and the flat sides of the loop are to the fore and aft.

A mounting plate for the loop (either of the three types) should be drilled as shown in figures 15 and 16, and secured to the aircraft structure in such a manner that the loop base will be level during normal flight. Holes should be made in the skin of the aircraft to permit the passage of the rotator mechanism (Types MN 20 and 24), the loop transmission cable, and the securing screws. Sufficient clearance should be available inside the fuselage for the attachment and removal of the cables. A velutex, or similar gasket should be used between the loop mounting base and the skin of the aircraft to make a water-tight seal.

The Type MN-20A or the Type MN-24A Rotatable Loop may be mounted on the top or bottom of the ship. The only difference between the two mountings lies in the choice of tachshaft couplings found on the bottom of the loop base. If the loop is mounted on the top of the ship when the Type MN-52G or the Type MN-52J Azimuth Control is used, tachshaft coupling #2 is to be used. If mounted on the bottom, tachshaft coupling #1 is to be used (see figure 26).

If the Type MR-15A Crank Drive is used with the Type MN-22A or the Type MN-40D Azimuth Control a chart of Mechanical Cable connections is given in figure 24. If the Azimuth Control is between the Type MR-15A Crank Drive and the loop Mechanical Cable connection #1 is used if loop is mounted on top of the ship. Connection #2 is used if the loop is mounted on the bottom of the ship.

If the Type MR-15A Crank Drive is between the Azimuth Control and the loop, Mechanical Cable connection #2 is used if the loop is mounted on top of the ship. Connection #1 is used if the loop is mounted on the bottom of the ship.

d. TYPE MN-40D AZIMUTH INDICATOR OR TYPE MN-22A AZIMUTH INDICATOR.—The azimuth indicators should be mounted so that the dials are easily readable from the operators position with a minimum of paralax. Figure 18 shows mounting dimensions for the Type MN-40D Azimuth Indicator, and figure 19 shows mounting dimensions for the Type MN-22A Azimuth Indicator. Either one of these units may be used and section IV, paragraph 20 *c* describes the differences. To enable mounting the azimuth indicator in that position which faciliititates the approach of the tachshafts and still retain indications relative to the ships heading, the zero positions of the dials may be shifted to any of four 90-degree separate positions. This change of position may be accomplished by removing the snap ring and glass, removing the eight dial holding screws and rotating the dial to the desired position. When replacing the screws, use a small amount of glyptal cement to hold them in place. Such a shift in the zero position of the dials will necessitate resetting of the cam of the MN-22A or the cam strip of the MN-40D. The mechanical cable must be attached to that azimuth indicator pinion which causes the pointer to rotate in the same direction as the loop (see figure 24). Zero indication on the outer dial of MN-22A should correspond with the zero bearing of the loop.

Two instrument lamps have one side grounded and the single wire shielded cable supplies the power to these lamps. Internal dropping resistors permit these 3-volt lamps to operate from the aircraft 12-volt power source.

e. THE TYPE MN-52G AZIMUTH CONTROL is designed for mounting on the instrument panel or alongside of the pilot where it may be conveniently operated and read with a minimum of parallax. Figure 17 shows the mounting dimensions for TYPE MN-52G AZIMUTH CONTROL. The mechanical cable connecting the Azimuth Control and the Loop mechanism must be so connected that the dial pointer on the Azimuth Control reads zero when the plane of the loop is set perpendicular to the aircraft's line of flight.

THE TYPE MN-52J AZIMUTH CONTROL is mounted exactly in the same manner as the TYPE MN-52G and the mounting dimensions shown for TYPE MN-52G in figure 17 apply to the MN-52J without alteration.

f. TYPE IN-4A LEFT-RIGHT INDICATOR.—The left-right indicator is designed to fit standard $3\frac{1}{3}$-inch instrument panel mounting holes. Space is normally available for the indicator on the instrument panel near the other flight instruments. Mounting dimensions are shown in figure 17. Clearance must be allowed for the installation of the connecting cable. It will not be necessary to shock mount the left-right indicator if the panel on which it is mounted is provided with shock absorbers. For other installations, shock

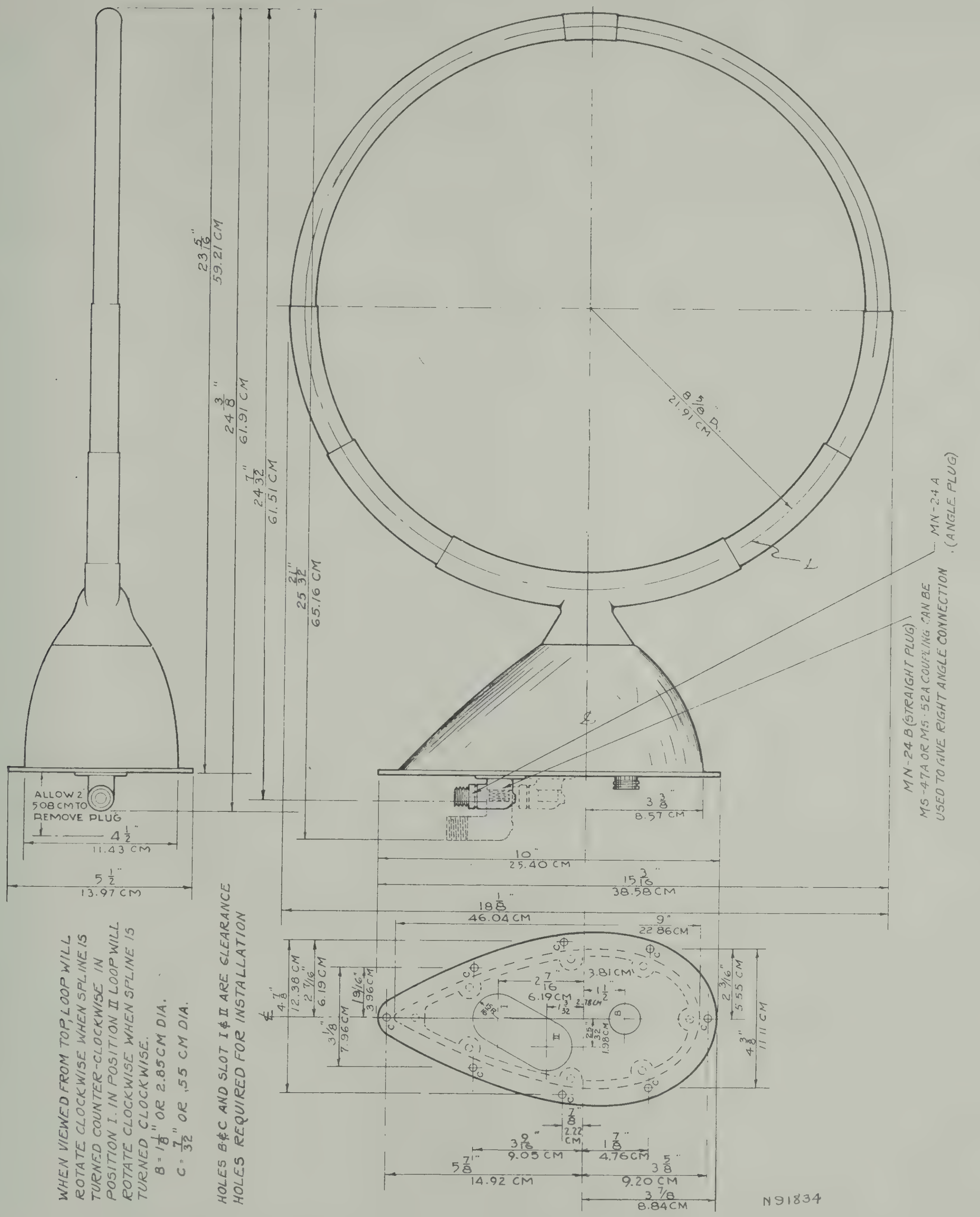


Figure 16 — Type MN-24 Rotatable Loop, Outline and Mounting Dimensions

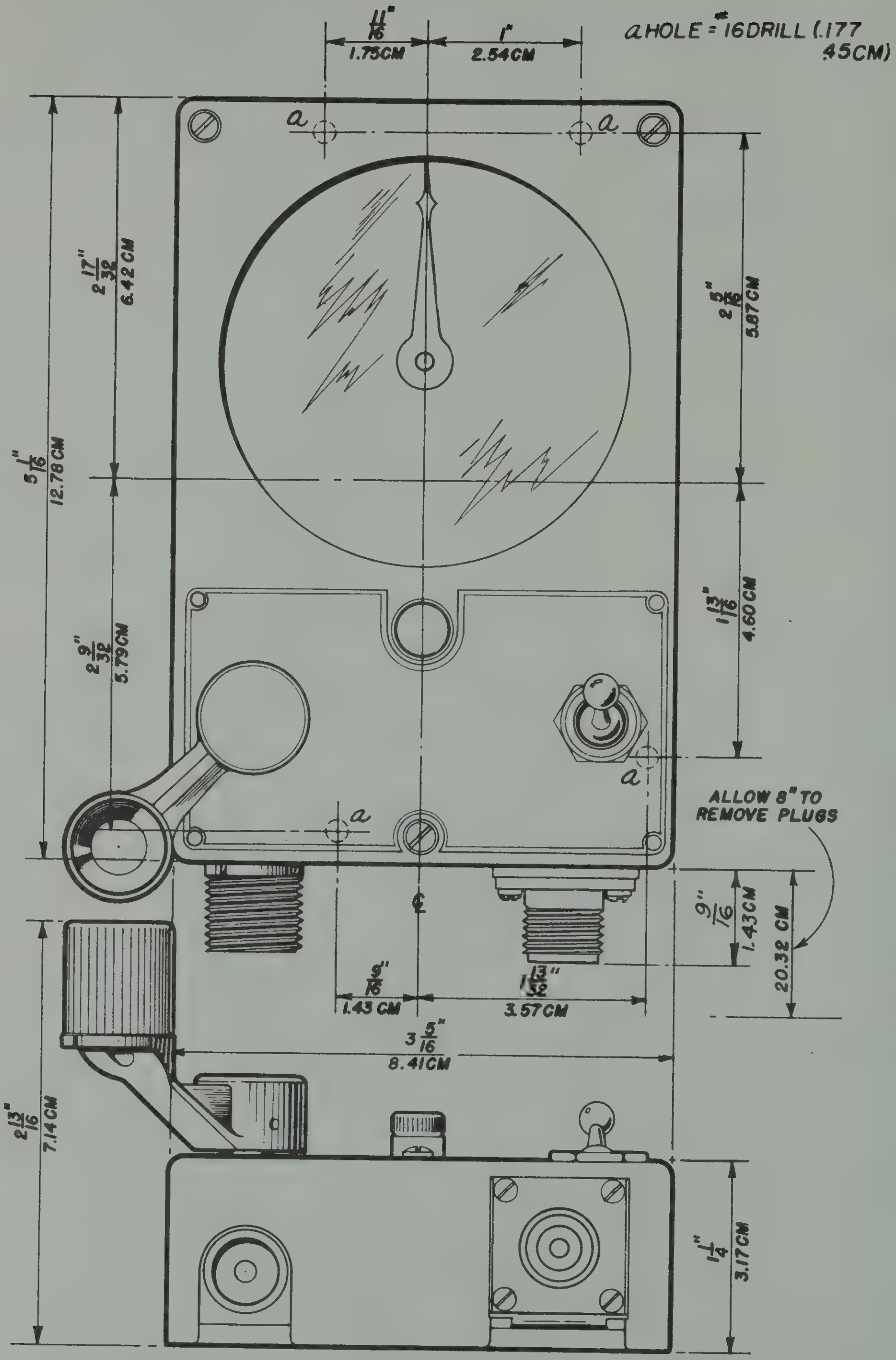


Figure 17 — Type MN-52G Azimuth Control, Outline Dimensions

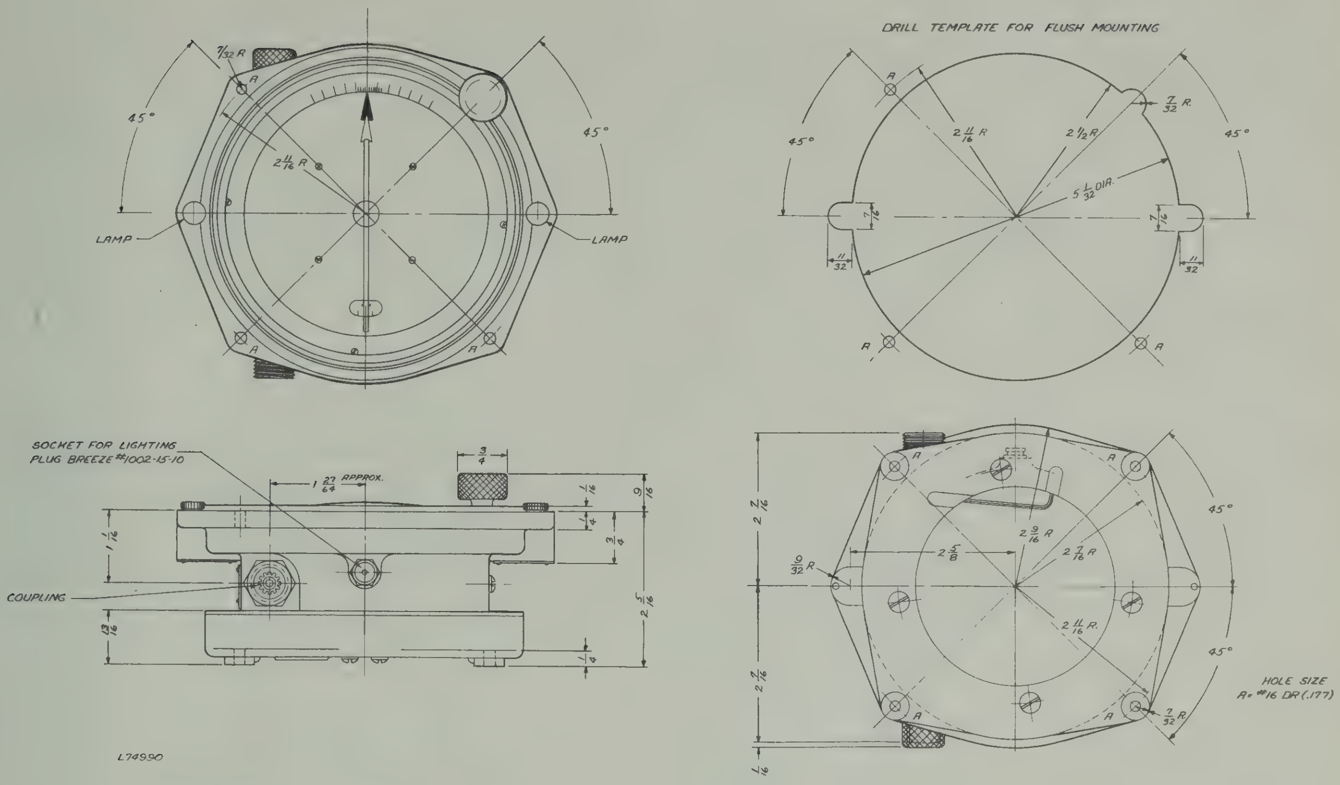


FIGURE 18 — TYPE MN-40D AZIMUTH INDICATOR, OUTLINE AND MOUNTING DIMENSIONS

mounting must be provided. If only one left-right indicator is used with the installation, the AA18824-1 field resonating meter load must be connected as shown in figure 63.

g. TYPE MS-14 JUNCTION BOX.—The junction box should be fastened securely to the principle structure of the aircraft at a location where it will be accessible for circuit checking and making wiring connections. Holes must be drilled in the bottom of the box for mounting. Figure 21 shows the mounting dimensions. Access may be had to the terminals and the wiring by releasing the two Dzus fasteners and removing the cover. Figure 30 shows a typical cordage (unit interconnection) diagram and figure 79 shows a typical system (unit interconnection wiring) diagram.

Holes must be cut in the sides of the junction box to receive the cable connectors. The cable connectors should be placed where they are most convenient for the particular installation section II, paragraphs 6*f*(1), 6*f*(2), and 6*f*(3) explain the use and mounting of the cable connectors.

(1) CLAMP TYPE CONNECTOR.—Cables which have the clamp type connector are complete for mounting to the junction box. The clamping arrangement consists of a clamp and a nut. The clamp is a little larger than the nut and has a slot cut completely through the threaded portion. Threading the nut on the clamp will result in a decrease in the diameter of the clamp which secures the clamp to the ferrule.

A hole must be cut in the side of the junction box just large enough to allow the threads of the clamp to pass through but not large enough to pass the shoulder of the clamp. Place the clamp from the inside of the box through the hole so that the threads protrude from the outside of the box. Temporarily place the nut over the ferrule of the cable. Thread the wires and the ferrule of the cable into the clamp as far as possible. Engage the threads of the nut with those on the clamp and tighten nut until the complete assembly is secure to the junction box.

(2) COUPLING NUT TYPE CONNECTOR.—Cables which have the coupling nut type connector require a standard Breeze box connector of the Series 28 and a lock nut for this connector which is a Breeze Series 6. The connector must be a size which will receive the coupling nut of the cable. The following table lists the Breeze and Bendix numbers for each of the cables requiring this type connector.

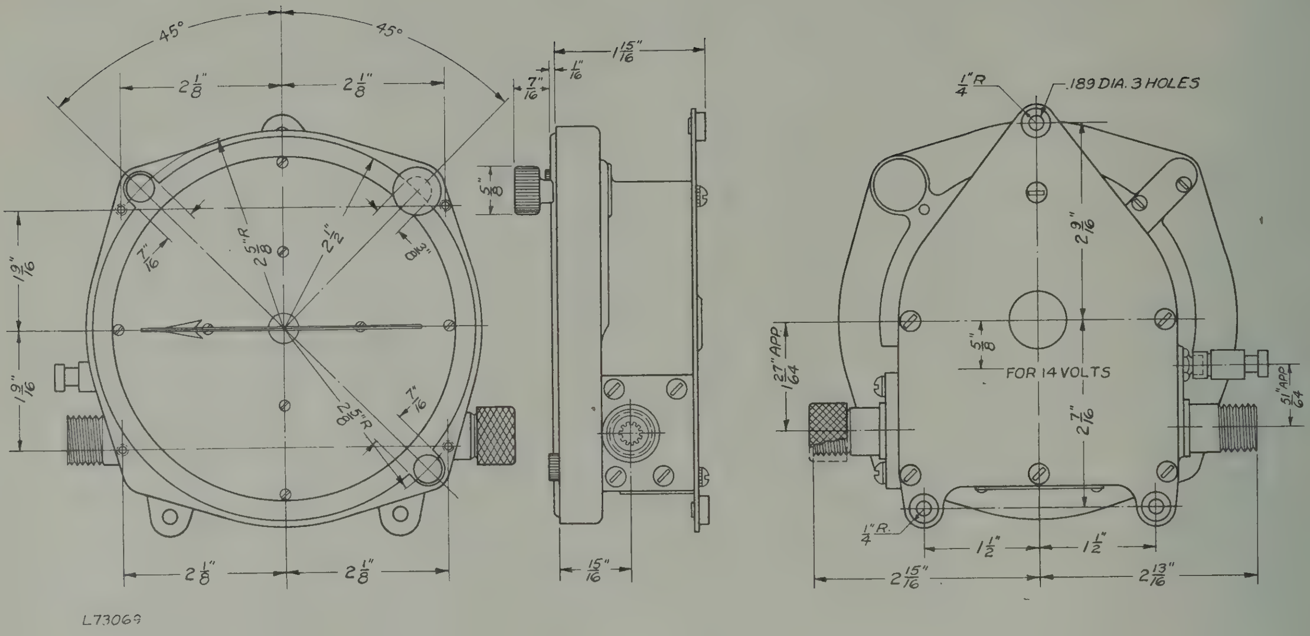


Figure 19 — Type MN-22A Azimuth Indicator, Outline and Mounting Dimensions

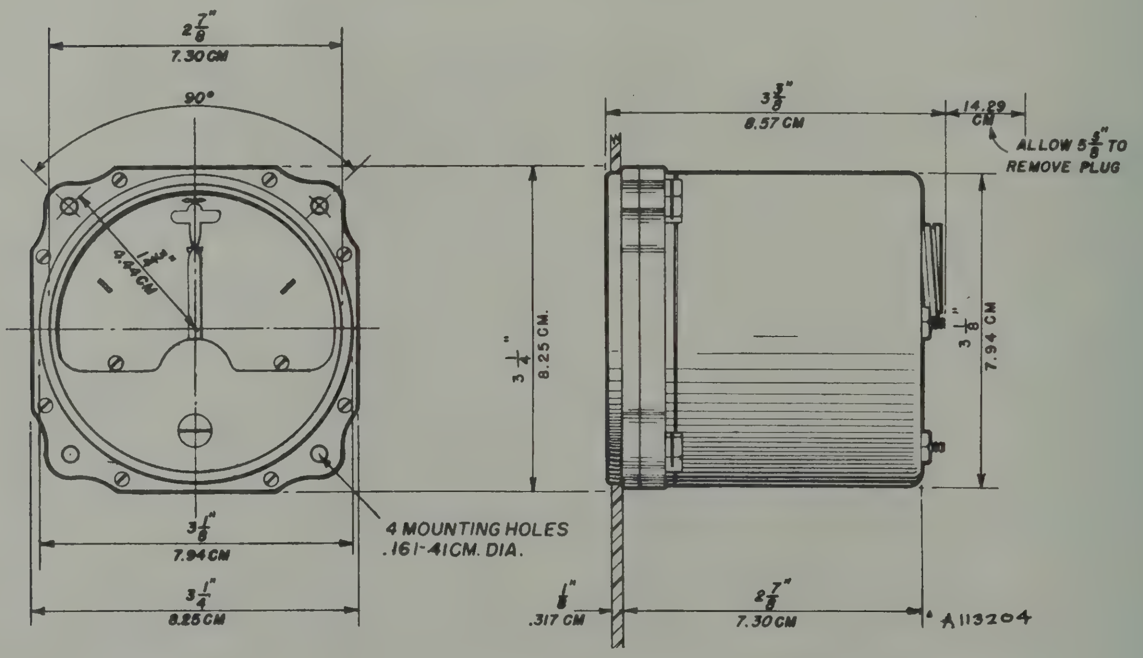


Figure 20—Type IN-4A Left-Right Indicator, Outline and Mounting Dimensions

Complete Cable Assembly Part Number	*Function of Cable*	*Box Connector*		*Lock Nut*	
		Bendix Part No.	*Breeze Part No.*	*Bendix Part No.*	*Breeze Part No.*
AC58267-3 or AC58267-4	Type IN-4A Left-Right Indicator to Junction Box	A3193-2	28-0376	A214-1	6-0312
AC59728-3 or AC59729-4	Remote Control Unit to Junction Box	A3196-4	28-0625	A214-3	6-0625
AC59728-3 or AC59728-4	Radio Compass to Junction Box	A3196-4	28-0625	A214-3	6-0625

A hole must be cut in the side of the junction box just large enough to allow the threads of the connector to pass through but not large enough to pass the shoulder of the connector. Place the connector from the inside of the box through the hole so that the threads protrude from the box. Secure the connector to the junction box with the lock nut. Thread the wires through the connector and secure the cable to the connector by tightening the coupling nut.

(3) INSTRUMENT LAMP CABLE CONNECTION.—The cable Bendix part no. AA26172-1 which supplies voltage to the instrument lamps is complete with a rubber grommet.

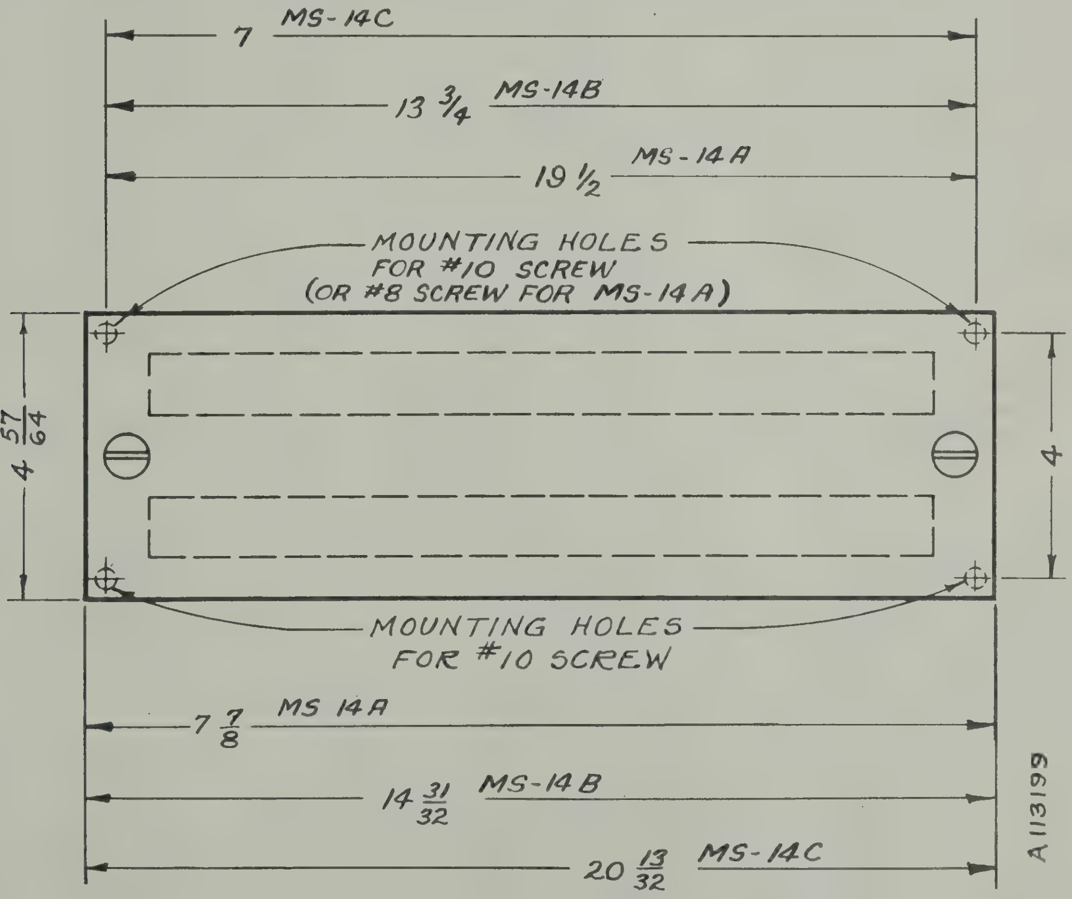


Figure 21 — Type MS-14 Junction Box, Outline and Mounting Dimensions

To secure the cable to the junction box, a hole should be cut in the box large enough to fit in the groove of the grommet but not large enough to allow the grommet to slide through the hole. Remove the grommet from the cable and press it half-way through the hole in the box so that a part of the grommet protrudes from each side of the junction box side. Thread the cable through the junction box and wire to the correct terminal or secure by means of cable clamps.

h. TYPE MR-15A CRANK DRIVE.—Mount the crank drive where it is convenient to the operator. Figure 22 shows the mounting dimensions.

i. TYPE MR-57A TUNING METER.—If a tuning meter is used it should be mounted where visible to the operator. Figure 23 shows the mounting dimensions. If the tuning meter is not used, terminal 18 of receptacle J4 must be grounded.

j. NON-DIRECTIONAL ANTENNA.—The type MN-26 Radio Compass is designed and adjusted to

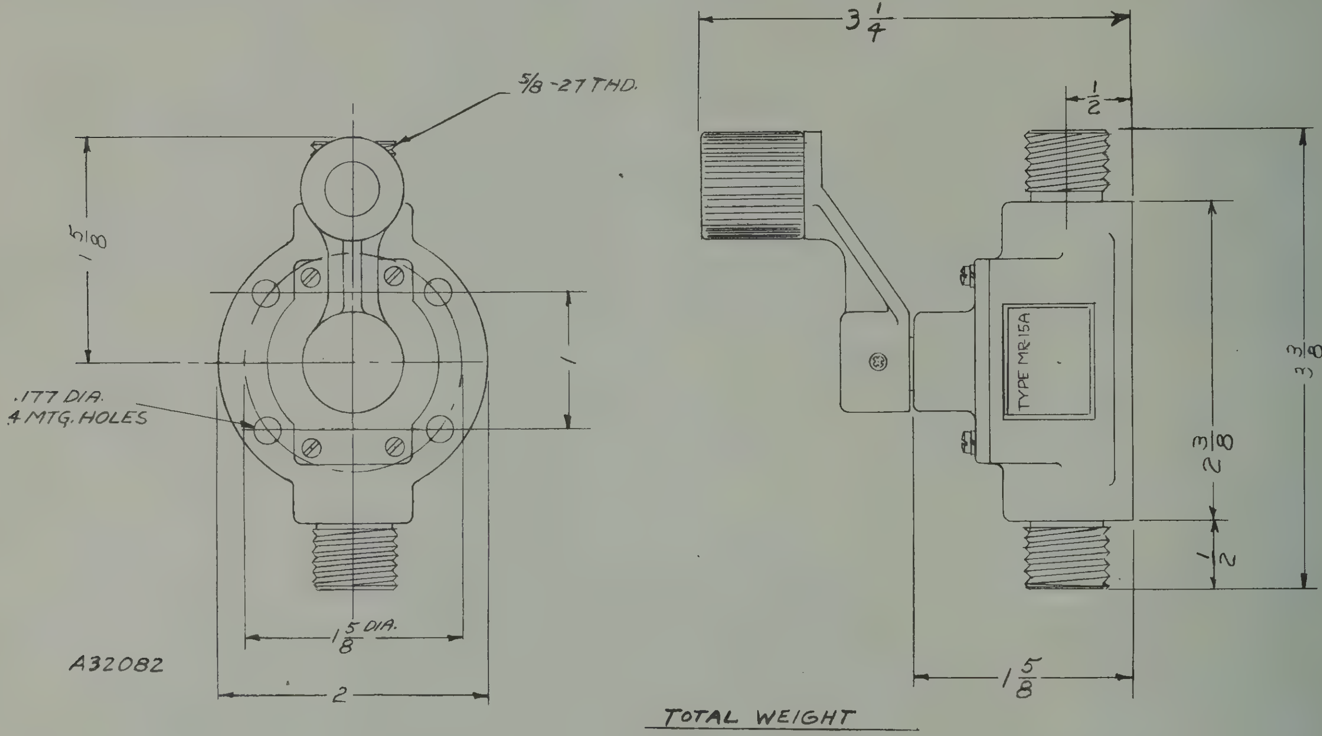


Figure 22 — Type MR-15A Crank Drive, Outline and Mounting Dimensions

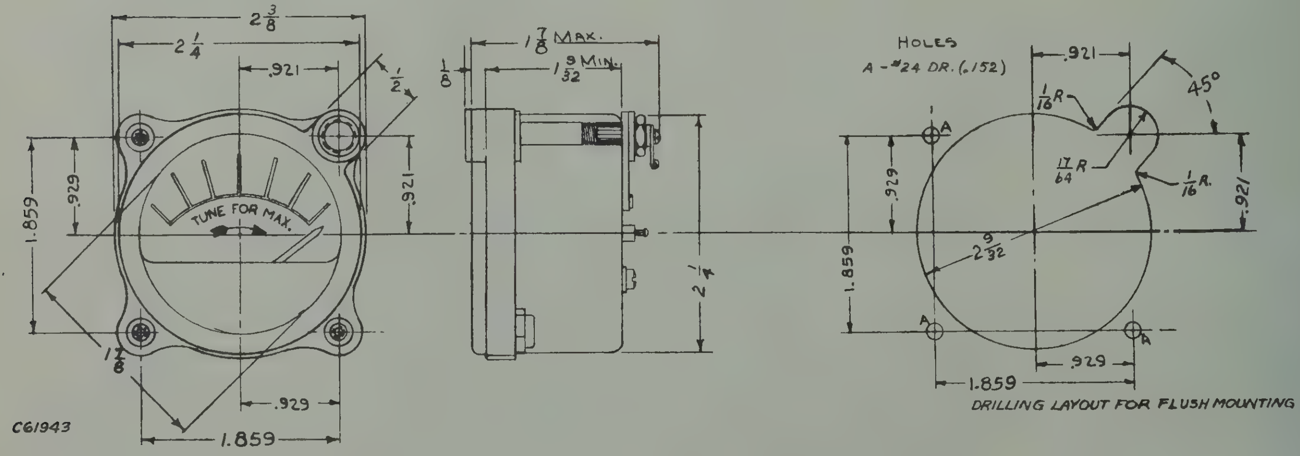
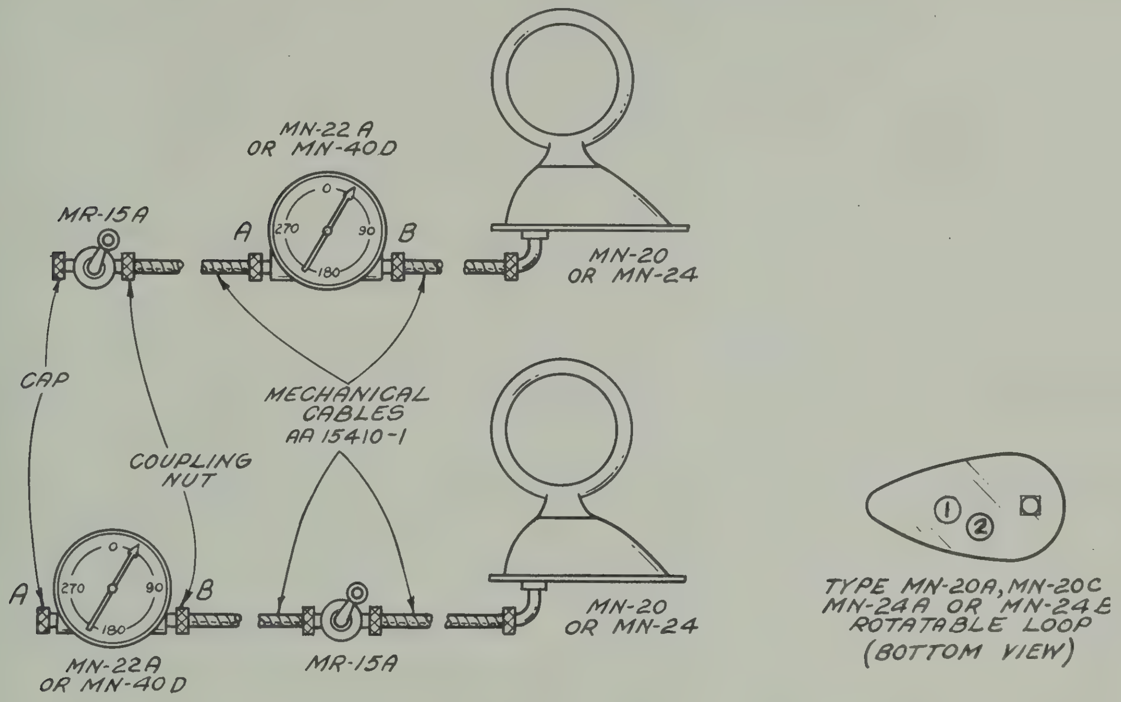


Figure 23 — Type MR-57A Tuning Meter, Outline and Mounting Dimensions

operate in conjunction with a vertical antenna having an effective height of one half meter, a capacity of 100-micromicrofarads and a resistance between 1 and 10-ohms, with the exception of Types MN-26W, X and M, when the antenna should have an effective height of $\frac{1}{4}$ meter and a capacity of 50 micromicrofarads. The type of antenna which will be used in any particular installation will be dictated by consideration of space and support structures available on the aircraft. On aircraft which will accommodate any one of several effect and the amount of signal pick-up. No antenna or lead-in should be placed closer than 3 feet from the loop. The portion of the lead-in inside the fuselage should be flexible insulated wire mounted so that the capacitance to ground does not exceed 15 micromicrofarads. If a "spike" or "whip" antenna is used, the lead-in must be less than 2 feet long. The lead-in wire should be kept as short as possible both on the inside and outside of the aircraft and should be fed into the aircraft through a dual-bowl type insulator such as



MOUNTING OF LOOP	CABLE CONNECTION ON INDICATOR	CABLE CONNECTION ON LOOP
TOP OF SHIP	A	1
TOP OF SHIP	B	2
BOTTOM OF SHIP	A	2
BOTTOM OF SHIP	B	1

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FIGURE 24 — LOOP TUNING CABLE CONNECTION

types of antenna installations, it is desirable that the type be used which most nearly meets the above requirements and which has the largest ratio of vertical to horizontal length. Vertical rod antennas and T-type wire antennas supported by stub-masts have been found satisfactory. Radio compass antennas are usually kept shorter than the transmitting or receiving antennas to reduce the amount of horizontal antenna Bendix part no. AC57339-1. A suitable amount of slack must be allowed at the radio compass to permit free action of the shockmount.

k. CABLES.—The electrical cables (with the exception of the loop transmission cable) may be constructed at time of installation if this is preferable to purchasing the complete cables. Section II, paragraph 7 describes the construction of electrical cables.

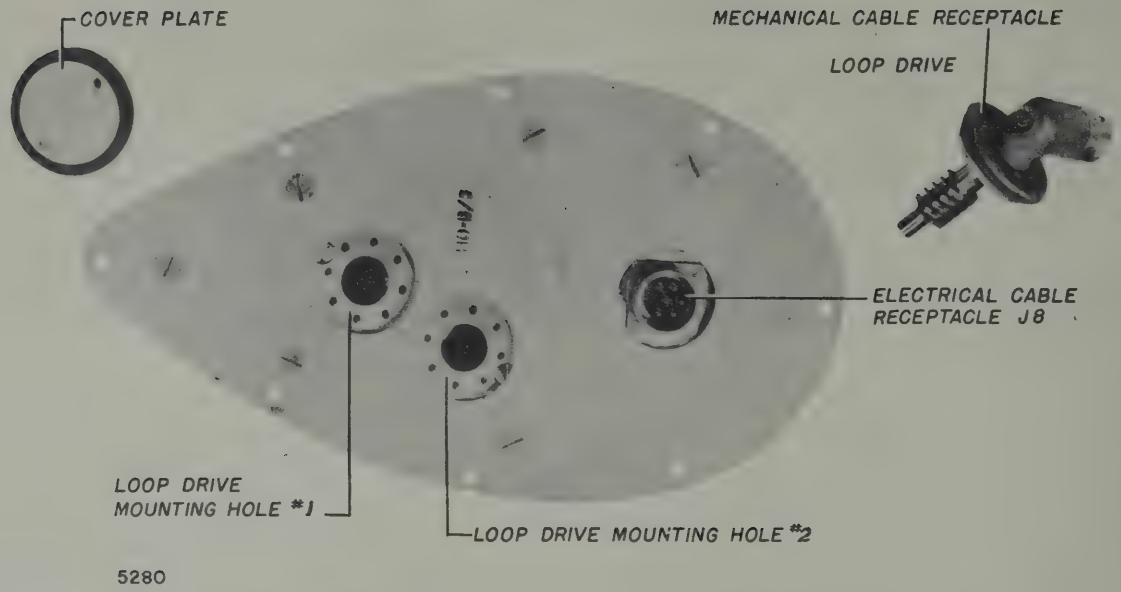

FIGURE 25 — TYPE MN-20 OR MN-24 ROTATABLE LOOP, BOTTOM VIEW

The equipment and cables must not interfere with the aircraft controls nor with the other instruments or equipment. Figures 30 and 79 show a typical interconnection. Consult the Systems Engineering Department, Bendix Radio Division, Bendix Aviation Corporation for installations which require special treatment.

The electrical and mechanical cables should be securely fastened in place, where necessary, to prevent abrasion or vibration. Cables connecting to the radio compass should be unsupported for a distance of two feet from the unit and should have enough slack to permit free action of the shock mounting. The loop transmission cable (AC55966) should be protected with friction tape wherever it touches another metallic surface or should be securely bonded.

Do not alter the length of the loop transmission cable (AC55966). If it is too long, the excess length may be coiled wherever convenient. This cable is furnished in any required length between 42 to 168 inches but should never be altered unless precautions are taken to adjust the inductance and capacitance as specified in paragraph 7 *d*.

l. LOOP TUNING CABLE.—The mechanical cables which link the loop to azimuth indicator and crank drive should be connected so that the plane of the loop is perpendicular to the aircraft's line of flight when the azimuth indicator dial reading is zero. After setting the two units, tighten the shaft securely and check the installation by rotating the crank drive several degrees each way, then resetting to zero reading of the azimuth indicator. If the mechanical cable has been properly aligned, the dial scale will read zero when the loop is at right angles to the line of flight. It is also important that the loop drive be in the proper opening of the loop, otherwise the loop may not rotate in the same direction as the azimuth indicator, resulting in incorrect bearings. The correct combinations are shown in figure 24. A cover plate is provided to cover the opening not used by the loop drive. (See figure 25.)

m. ALTERING THE LENGTH OF MECHANICAL CABLES.—The following is a simple method of cutting and terminating flexible mechanical cable shafts and conduits (armored housing) without special tools or equipment. Refer to figure 27 for nomenclature and location of parts.

The conduit should be measured for length in a relaxed condition, neither stretched or compressed. This condition may be assured by coiling the conduit to approximately one foot in diameter and then carefully uncoiling it on the surface on which it is to be measured. It may be cut to the measured length with a hacksaw. If the cable is being cut at one end after installation within the aircraft, the shaft is usually inside the conduit and care should be used in cutting the conduit so that no strands of the shaft will be fractured.

After the conduit has been cut to length, the shaft should be marked about $\frac{1}{4}$ inch beyond the end of the conduit. The conduit should then be compressed or pushed away from this mark. A coupling nut and a ferrule are then slipped over the end of the housing. Parallel clamps must be tightly affixed to the shaft about 2 inches on each side of the mark. The shaft

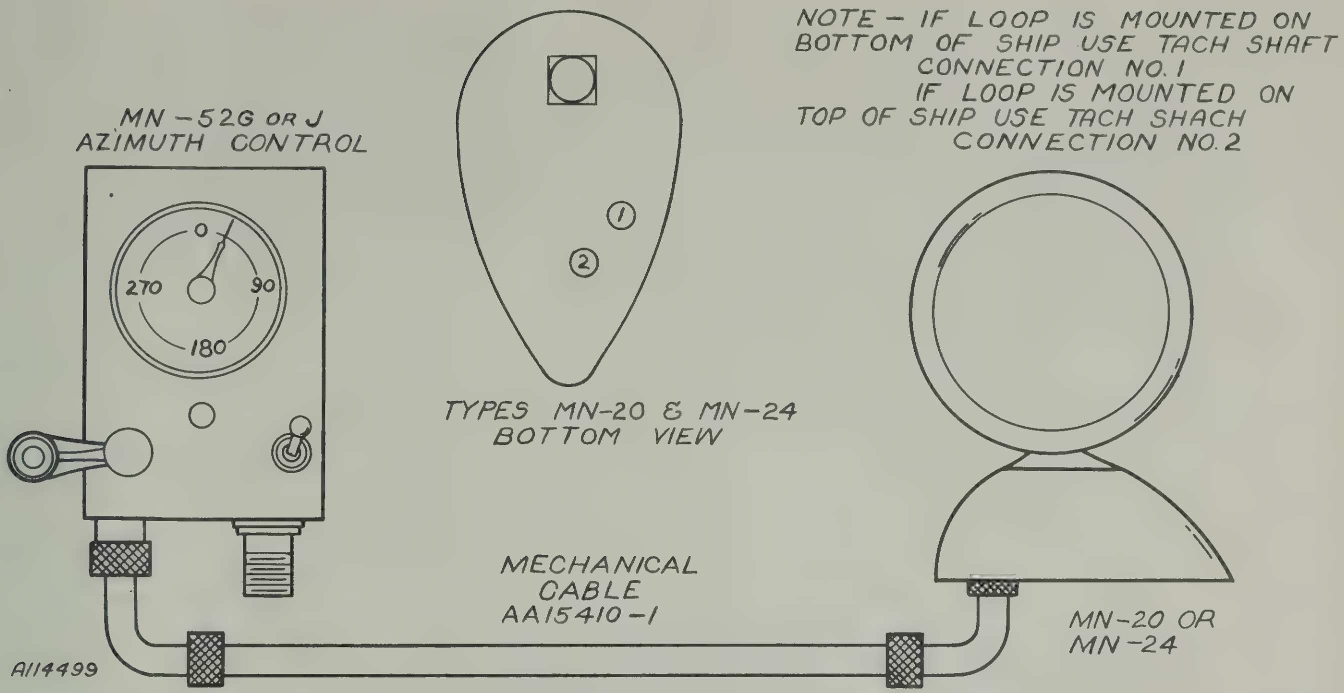

FIGURE 26 — LOOP TUNING CABLE CONNECTION FOR TYPE MN-52G AND MN-52J AZIMUTH CONTROL

should then be thoroughly tinned with soft solder and a 200 watt electric soldering iron. The tinning should extend about one inch on each side of the mark previously made on the shaft. After the shaft is thoroughly tinned it may be cut at the mark with a hacksaw.

Before releasing the parallel clamp on the piece of shafting which is to be used, the spline must be fastened to the assembly. The spline must be well tinned inside of the hole which takes the shaft. The shaft should be draped downward and the spline heated while being held by a pair of pliers. When the spline is hot enough to freely melt solder within the upturned hole, it is carefully forced upward on the shaft until it is securely "seated" with the shaft touching the bottom of the hole. While holding the assembly with the pliers, and with the solder still in liquid state, all excess solder should be quickly wiped off with a heavy cloth.

After the solder has cooled enough to solidity, release the pliers and parallel clamp. Stretch the conduit to its correct length and with a small center punch, dent the ferrule in four places around its periphery about $\frac{1}{8}$ inch from the rear and again in four places about $\frac{1}{4}$ inch from the first punch marks. The ferrule may be supported during this operation with a small metal block in which a "V" shaped slot has been cut. This completes the assembly.

n. RADIO COMPASS TO REMOTE CONTROL MECHANICAL CABLE.—If it is necessary to alter the length of the tuning cable consult section II, para-

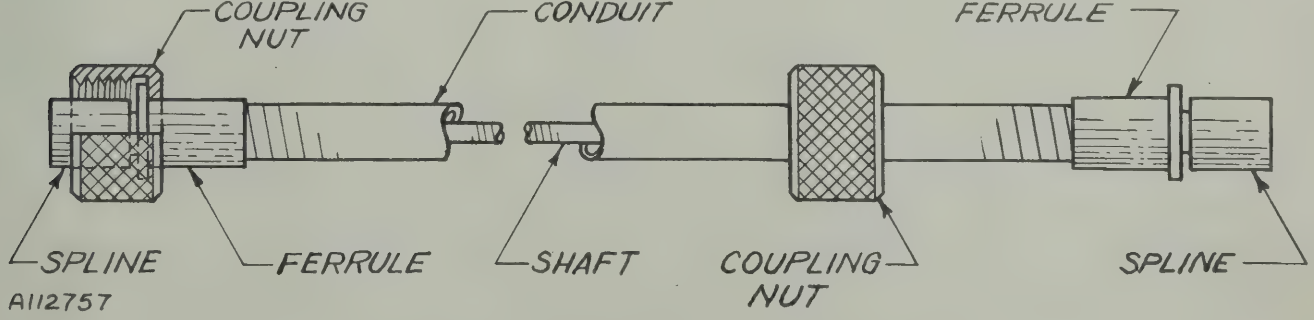

FIGURE 27 — MECHANICAL CABLE CONSTRUCTION

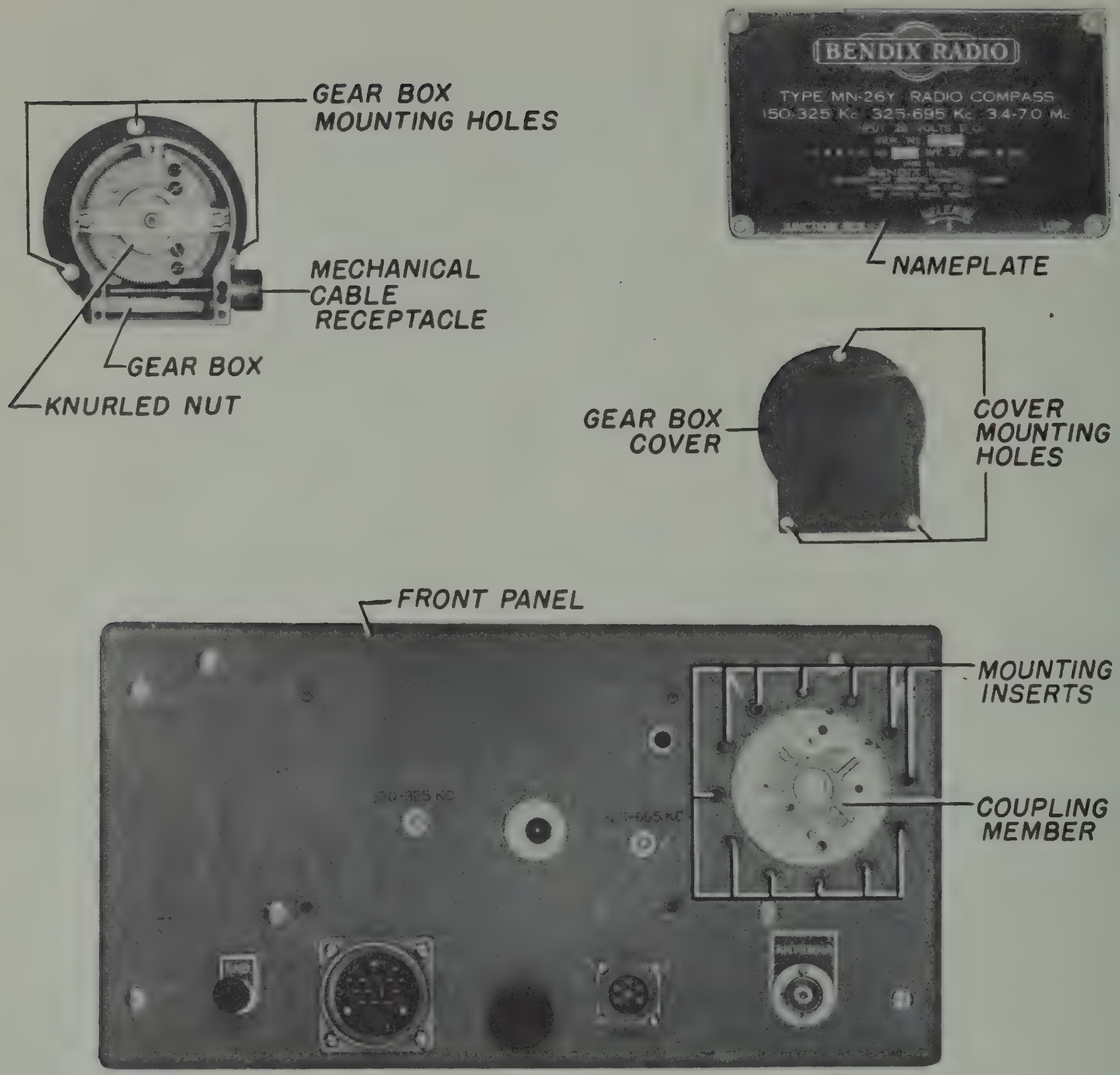

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Figure 28 — Type MN-26 Radio Compass, Gear Box

graph 6 *l*. The tuning cable should be bonded to the principal metallic structure of the aircraft at frequent intervals. The minimum bending radius of the tuning-shaft is six inches and not more than two-six-inch, 90-degree bends should be made in any one cable installation. Several bends of larger radius or greater angles may be permitted, however.

(1) CONNECTING TUNING CABLE.—To connect the mechanical cable from Type MN-26 Radio Compass to Type MN-28 Remote Control;

(*a*) Set the variable capacitor plates of Type MN-26 Radio Compass at maximum capacity (fully meshed). The stop in the gear box will prevent rotation beyond the maximum capacity.

(*b*) Set the band selector of Type MN-28 Remote Control to Band III.

(*c*) Rotate the TUNING crank until the ALIGN mark on the dial is centered under the index.

(*d*) Connect the mechanical cable between the receptacle of the remote control (see figure 3) and the gear box receptacle of the radio compass (see figure 2).

(*e*) Check the alignment by varying the TUNING crank and resetting the maximum variable capacitor setting (against the stop). The dial must reset on the ALIGN mark.

(2) CHANGE OF GEAR BOX POSITION.—The gear box mounted on the front panel of the radio compass (see figure 28) provides means for obtaining

the necessary reduction of rotation between the flexible shaft of the cable and the tuning capacitor. The flexible shaft connects through a spline and shaft to a worm which drives a split-spring-loaded worm gear provided with stops to limit the amount of rotation to 180-degrees. The hub of this worm gear is tapered to fit onto a similar taper on the gear shaft, pressure for locking the gear onto the shaft being provided by a knurled nut. When this knurled nut is loosened, the shaft may be turned to a setting without turning the gears. The shaft of the variable capacitor is provided with a coupling member consisting of a bar having a pin on each of the two tips, and the shaft of the gear box is provided with a similar bar. The bars are coupled together, when the gear box is attached to the front panel, by means of a coupling having four slotted arms which engage the pins on the variable-capacitor-bar and the gear-box-shaft-bar. The panel is provided with 12 inserts, 30-degrees apart in a circle, and the gear box is provided with three holes 120-degrees apart. This enables the gear box to be secured, with three screws, in any one of 12 positions. To enable the mechanical cable to be run to the unit with the minimum of bending, the gear box may be mounted in one of these 12 positions as follows:

(*a*) Connect the remote control to the gear box on the compass by means of the mechanical cable and rotate the TUNING crank on the remote control in a *counterclockwise* direction until the gear box stops prohibit further rotation.

(*b*) Remove the cover from the gear box and loosen the knurled nut a fraction of a turn. This permits the gear box and the variable capacitor to be independently rotated.

(*c*) Remove the three screws which mount the gear box to the panel but do not pull gear box forward as the coupling may be loose enough to become disengaged.

(*d*) Hold the variable capacitor in its maximum (fully meshed) position.

(*e*) Rotate the gear box to its new position without allowing it to fall forward. It may be necessary to pull the gear box slightly forward to allow it to pass the panel mounting screws in the upper-right-hand corner of the panel or over the name plate. These panel mounting screws may be removed until the gear box has been rotated to its new position, if it is desirable. If the coupling becomes disconnected it must be engaged before adjustment is continued. Secure the gear box to the panel with the three mounting screws.

(*f*) Tighten the knurled nut and replace the cover.

(*g*) With the mechanical cable still disconnected, rotate the TUNING crank until the ALIGN mark is centered under the index.

(*h*) Connect the mechanical cable between the remote control unit and the gear box on the radio compass. Rotate the TUNING crank throughout its range to see if minimum and maximum capacitance is obtained at the end points of the dial scales.

o. ELECTRICAL CABLES.—Due to the difficulty of stocking a variety of wire colors in large number of sizes, numbered tabs are slipped over the ends of the wires in the cable for identification. These tabs are usually numbered to agree with the pin number of the plug (unless otherwise specified). The tab numbers will be useful when wiring the cables into the junction box.

In addition to the cables, it will be necessary to wire the battery connections, through a master switch and fuse, into the junction box. The negative (ground) wires should be connected to the metal surfaces of the junction box, except in the case of Type MN-26CA which is positive grounded.

Cable fittings should make good electrical contact to the junction box and should be mechanically tight. Cable wires and other wires should be connected to the terminals by means of soldering lugs. It is good practice to use no more than four wires on each terminal. If possible, leave unused those terminals which are adjacent to those used for high voltage wiring. Terminals which are jumpered together should be adjacent if at all possible.

p. LOOP TRANSMISSION CABLE. (see figure 29).—*Do not alter the length of the loop transmission cable AC559661-*. If it is too long, the excess may be coiled wherever convenient. If alteration of this cable is *absolutely essential* precautions must be taken to adjust the inductance and capacitance to *exactly* that of the original. This cable should be protected with friction tape wherever it touches another metallic surface or should be securely bonded. Place one plug of the cable into receptacle J7 of the radio compass (see figure 2) and the other plug into the electrical cable receptacle J8 of the loop (see figure 25).

7. CABLE DESIGN.

Interconnecting cables carrying relatively high battery currents should be as short as practical and contain wire sizes which will result in not more than one volt loss in the entire length (see tables). Wire insulation should be adequate for the voltage requirements of each wire in the cable. No wire should be used with less than 1000-volt breakdown rating. High voltage

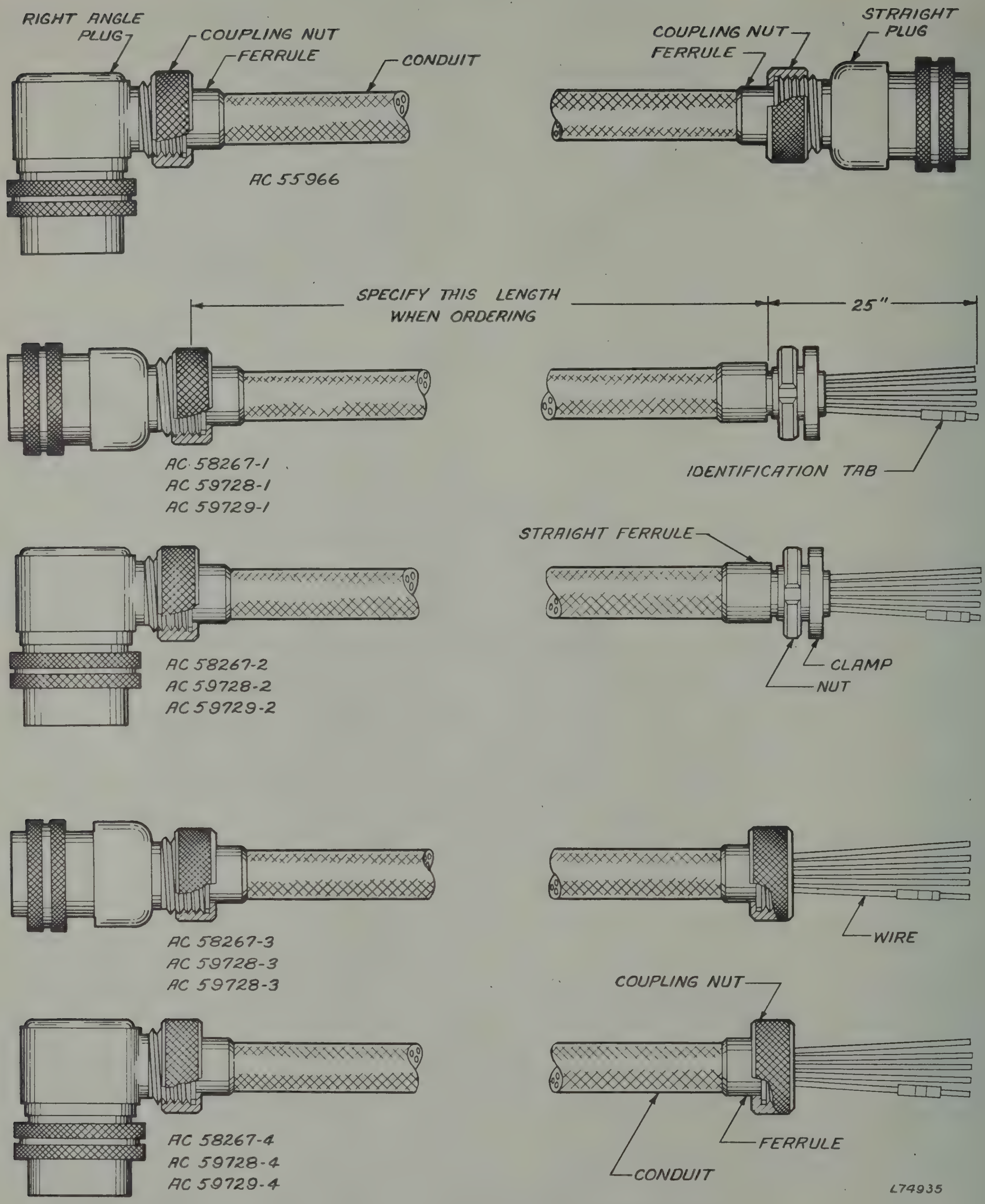


FIGURE 29 — ELECTRICAL CABLE CONSTRUCTION

wires and wires for receiver cathode circuits should have high quality insulation such as synthetic flexible glass. Lenzac wire is used for all electrical functions of receiver cables except for those controlling the cathode circuits of tubes such as beat frequency oscillators, or 48 cycle oscillators, where glass insulated wires is desirable. The metal braid on shielded wires and the conduits on cables should be connected to the metal surfaces of the junction box. The flexible conduit size shall be determined by adding the cross sectional areas of all wires used in the cable. The sum of the areas shall not exceed the "Usable Area" for the conduit size listed in the "Flexible Conduit Data" table.

If it is desirable to construct cables rather than purchase the complete cables, the following will be helpful.

The braid on shielded wire should be insulated from the plug pins and all metal surfaces at the plug end of the cable. Connection to the braid should be made only at the junction box.

In consideration of the wire size to be used to handle the current of any given function, the voltage loss in 30 feet as given in the table should be consulted. The wire size is also governed somewhat by the recommended maximum conductor size for the pins of the plug. Recommendations by Cannon Electric Development Company are:

Contact Rating in Amperes	*Max. Wire Gauge*
10	16
15	14
30	10
40	8
60	6

The wire size for ground circuits in a control box need *not* be as large as for the plus 12 or 24 volt circuits as in the case of major equipment, since the ground circuit in a control box normally carries only the current of pilot lights, relays, etc.

Dash numbers are appended to the part number of any wire (except Airspeed) and serve to designate the color of the wire in accordance with the RMA color code as follows:

−0 = Black	−3 = Orange	−7 = Violet
−1 = Brown	−4 = Yellow	−8 = Gray
−2 = Red	−5 = Green	−9 = White
	−6 = Blue	

For example, wire number A14050-91 indicates number 18 Lenzac wire having a white (9) background with a brown (1) tracer. A30158-4 indicates number 22 shielded wire having a yellow (4) color.

NOTE: A3015*8* shielded wire should be used in solid or tracer colors only. A3015*9* shielded wire should be used in "half and half" color combinations only. Airspeed wire is available in one color only and no dash numbers may be appended to its part numbers.

To determine the smallest conduit size which will accommodate the number and sizes of conductors to be used in the cable, the tables should be used. The sum of the wire areas of all conductors should not be greater than the "usable area" of the conduit selected. For example, no more than seven #18 Lenzac wires (area .006) should be used in a $\frac{3}{8}$ conduit (usable area .044), (.044 ÷ .006 = 7.33). Exceptions to this may be made only on cables shorter than four feet in length.

Wire and Conduit Reference Tables

O.D. = Overall outside diameter of wire in decimals of an inch.

Area = Cross sectional area of wire (including insulation) in square inches.

Synthetic Glass Wire				
Part No.	*Wire Gauge*	*Voltage*	*O.D. ±5%*	*Area*
A30147	4	500	.331	.086
A30144	6	500	.277	.060
A30141	8	500	.233	.040
A30138	10	500	.185	.026
A30139	10	1250	.190	.028
A30140	10	5000	.225	.039
A30135	12	500	.147	.017
A30136	12	1250	.155	.019
A30137	12	5000	.200	.030
A30132	14	500	.127	.013
A30133	14	1250	.135	.014
A30134	14	5000	.180	.025
A30129	16	500	.103	.008
A30130	16	1250	.119	.011
A30131	16	5000	.159	.020
A30126	18	500	.089	.006

Synthetic Glass Wire				
Part No.	*Wire Gauge*	*Voltage*	*O.D. ±5%*	*Area*
A30127	18	1250	.105	.008
A30128	18	5000	.145	.017
A30123	20	500	.082	.005
A30120	22	500	.074	.004
Airspeed Wire				
A4657	6		.285	.063
A7809	8		.243	.046
Lenzac Wire				
A14051	10		.180	.025
A16754	12		.147	.016
A13876	14		.125	.012
A12417	16		.103	.008
A14050	18		.090	.006
A18125	20		.080	.005
A12416	22		.076	.005
A30158*	22		.135	.014
A30159*	22		.135	.014
A29525†	22 (2)		.199	.030
A29792†	22 (2)		.199	.030

* Single wire shielded, cotton insulation over shield.
† Shielded twisted pair, lacquered cotton insulation over shield.

Flexible Conduit Data

Conduit Size	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$
Inside Area	.110	.196	.037	.442	.785	1.227	1.767	3.142	4.906
Usable Area	.044	.078	.123	.177	.314	.491	.707	1.257	1.962

Wire Resistance and Current Rating

B. & S. Wire Gauge Number	*Copper Dia. in Inches*	*Feet Per Ohm*	*Ohms Per Foot*	*Max. Amps (.5v Loss in 30 Ft.)*	*Max. Amps (1.v Loss in 30 Ft.)*
0	.3249	9,980.0	.000100	166.	332.
1	.2893	7,914.0	.000126	132.	264.
2	.2676	6,270.0	.000159	105.	210.
3	.2294	4,977.0	.000200	83.	166.
4	.2043	3,947.0	.000253	66.	132.
5	.1819	3,130.0	.000319	52.5	105.
6	.1620	2,482.0	.000402	41.5	83.
7	.1443	1,969.0	.000508	33.0	86.
8	.1285	1,561.0	.000640	26.25	52.50
9	.1144	1,238.0	.000807	20.75	41.50
10	.1019	981.8	.001018	16.50	33.00
11	.09074	778.7	.001284	13.12	26.25
12	.08081	617.5	.001619	10.37	20.75
13	.07196	489.7	.002042	8.25	16.50
14	.06408	388.3	.002575	6.60	13.12
15	.05707	308.0	.003247	5.18	10.37
16	.05082	244.2	.004094	4.12	8.25
17	.04526	193.7	.005163	3.30	6.60
18	.04030	153.6	.006510	2.59	5.18
19	.03589	121.8	.008210	2.06	4.12
20	.03196	96.60	.01035	1.65	3.30
21	.02846	76.61	.01305	1.29	2.59
22	.02535	60.75	.01646	1.03	2.06

Note: Wire resistance doubles approximately every 3 wire sizes. Wire diameter doubles approximately every 6 wire sizes.

The cables which are available and specifically designed for the equipment described in this book are illustrated in figure 29, and have the following wires.

a. LEFT-RIGHT INDICATOR TO JUNCTION BOX CABLE CONSTRUCTION.—The parts required for construction are listed in section II, paragraph 7*a* (2), 7*a* (3), 7*a* (4), and 7*a* (5) and the cable is to be wired as listed in section II, paragraph 7*a* (1) below:

(1) CABLE WIRING.

Plug Pin No.	*Wire Color*	*Wire Size*
6	Not used	
5	White	#18
4	White	#18
3	White	#18
2	White	#18
1	White	#18

(2) LIST OF PARTS FOR AC58267-1 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30088	6-contact, straight
Conduit	1	A4651-2	⅜″ I.D., 0.515″ O.D.
Clamp	1	A18121-1	Breeze #78-0375
Nut	1	A18122-1	Breeze #79-0375
Straight ferrule	1	A18123-2	Breeze #113-1-0375
Ferrule	1	A18139-3	A. M. Hose Co. #75565-3
Coupling nut	1	A320-3	NAF #213017-3
Wire	5	A14050-9	#18
Tubing	5″	A13296-3	0.118″ I.D. Varflex

(3) LIST OF PARTS FOR AC58267-2 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30085	6-contact, right angle
Conduit	1	A4651-2	⅜″ I.D., 0.515″ O.D.
Clamp	1	A18121-2	Breeze #78-0375
Nut	1	A18122-1	Breeze #79-0375
Straight ferrule	1	A18123-2	Breeze #113-1-0375
Ferrule	1	A18139-3	A.M. Hose Co. #75565-3
Coupling Nut	1	A320-3	NAF #213017-3
Wire	5	A14050-9	#18
Tubing	5″	A13296-3	0.118″ I.D. Varflex

(4) LIST OF PARTS FOR AC58267-3 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30088	6-contact, straight
Conduit	1	A4651-2	⅜″ I.D., 0.515″ O.D.
Ferrule	2	A18139-3	A.M. Hose Co. #75565-3
Coupling nut	2	A320-3	NAF #213017-3
Box connector	1	A3193-2	NAF #213019-3
Lock nut	1	A214-1	NAF #213028-3
Wire	5	A14050-9	#18
Tubing	5″	A13296-3	0.118″ I.D. Varflex

(5) LIST OF PARTS FOR AC58267-4 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30085	6-contact, right angle
Conduit	1	A4651-2	⅜″ I.D., 0.515″ O.D.
Ferrule	1	A18139-3	A.M. Hose Co. #75565-3
Coupling nut	1	A320-3	NAF #213017-3
Box connector	1	A3193-2	NAF #213019-3
Lock nut	1	A214-1	NAF #213028-3
Wire	5	A14050-9	#18
Tubing	5″	A13296-3	0.118″ I.D. Varflex

b. RADIO COMPASS TO JUNCTION BOX CABLE CONSTRUCTION.—The parts required for construction are listed in section II, paragraphs 6*b* (2), and 6*b* (3), 6*b* (4), and 6*b* (5) and the cable is to be wired as listed in section II, paragraph 6*b* (1), below:

(1) CABLE WIRING.

Plug Pin No.	*Wire Size*	*Wire Color*
23	18	White
22	No Connection	
21	18	White
20	18	White
19	18	White
18	18	White
17	18	White
16	18	White
15	18	White
14	18	White
13	18	White
12	22	Blue-White
11	18	White
10	18	White
9	18	White
8	18	White
7	18	White
6	14	White
5	18	White
4	22	Blue-White
3	14	White
2	No Connection	
1	No Connection	

(2) LIST OF PARTS FOR AC59728-1 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30095	23-contact, straight
Conduit	1	A4651-4	⅝″ I.D., 0.765″ O.D.

Name of Part	Quantity	Bendix Part No.	Description
Clamp	1	A18121-7	Breeze #78-0625
Nut	1	A18122-7	Breeze #79-0625
Straight ferrule	1	A18123-4	Breeze #113-1-0625
Ferrule	1	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	1	A320-5	NAF #214017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	14	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	16″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

(3) LIST OF PARTS FOR AC59728-2 CABLE.

Name of Part	Quantity	Bendix Part No.	Description
Plug	1	A30601	23-contact, right angle
Conduit	1	A4651-4	⅝″ I.D. 0.765″ O.D.
Clamp	1	A18121-7	Breeze #78-0625
Nut	1	A18122-7	Breeze #79-0625
Straight ferrule	1	A18123-4	Breeze #113-1-0625
Ferrule	1	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	1	A320-5	NAF #213017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	14	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	16″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

(4) LIST OF PARTS FOR AC59728-3 CABLE.

Name of Part	Quantity	Bendix Part No.	Description
Plug	1	A30095	23-contact straight
Conduit	1	A4651-4	⅝″ I.D., 0.765″ O.D.
Ferrule	2	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	2	A320-5	NAF #213017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	14	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	16″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex
Box connector	1	A3196-4	NAF #213019-5
Lock nut	1	A214-3	NAF #213028-5

(5) LIST OF PARTS FOR AC59728-4 CABLE.

Name of Part	Quantity	Bendix Part No.	Description
Plug	1	A30601	23-contact, right angle
Conduit	1	A4651-4	⅝″ I.D., 0.765″ O.D.
Ferrule	2	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	2	A320-5	NAF #213017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	14	A14050-9	#18
Wire	2	A30159-69	#22 single shielded.
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	16″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex
Box connector	1	A3196-4	NAF #213019-5
Lock nut	1	A214-3	NAF #213028-5

c. CONTROL BOX TO JUNCTION BOX, CABLE CONSTRUCTION.—The parts required for construction are listed in section II, paragraph 6 *c* (2), 6 *c* (3). 6 *c* (4) and 6 *c* (5) and the cable is to be wired as listed in section II, paragraph 6 *c* (1), below:

(1) CABLE WIRING.

Plug Pin No.	Wire Size	Wire Color
16	No Connection	
15	14	White
14	No Connection	
13	14	White
12	18	White
11	22	Blue-White
10	18	White
9	No Connection	
8	18	White
7	18	White
6	18	White
5	18	White
4	18	White
3	18	White
2	22	Blue-White
1	18	White

(2) LIST OF PARTS FOR AC59729-1 CABLE.

Name of Part	Quantity	Bendix Part No.	Description
Plug	1	A30852	16-contact, straight
Conduit	1	A4651-4	⅝″ I.D., 0.765″ O.D.
Clamp	1	A18121-7	Breeze #78-0625
Nut	1	A18122-7	Breeze #79-0625
Straight ferrule	1	A18123-4	Breeze #113-1-0625
Ferrule	1	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	1	A320-5	NAF #213017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	7	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.950″ I.D. Varflex
Tubing	9″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

(3) LIST OF PARTS FOR AC59729-2 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A31770	16-contact, right angle
Conduit	1	A4651-4	$\frac{5}{8}$″ I.D., 0.765″ O.D.
Clamp	1	A18121-7	Breeze #78-0625
Nut	1	A18122-7	Breeze #79-0625
Straight ferrule	1	A18123-4	Breeze #113-1-0625
Ferrule	1	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	1	A320-5	NAF #213017-5
Wire	2	A30126-9	#18 synthetic glass
Wire	7	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	9″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

(4) LIST OF PARTS FOR AC59729-3 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A30852	16-contact, straight
Conduit	1	A4651-4	$\frac{5}{8}$″ I.D., 0.765″ O.D.
Ferrule	2	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	2	A320-5	NAF #213017-5
Box connector	1	A3196-4	NAF #213019-5
Lock nut	1	A214-3	NAF #213028-5
Wire	2	A30126-9	#18 synthetic glass
Wire	7	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	9″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

(5) LIST OF PARTS FOR AC59729-4 CABLE.

Name of Part	*Quantity*	*Bendix Part No.*	*Description*
Plug	1	A31770	16-contact, right angle
Conduit	1	A4651-4	$\frac{5}{8}$″ I.D., 0.765″ O.D.
Ferrule	2	A18139-5	A.M. Hose Co. #75565-5
Coupling nut	2	A320-5	NAF #213017-5
Box connector	1	A3196-4	NAF #213019-5
Lock nut	1	A214-3	NAF #213028-5
Wire	2	A30126-9	#18 synthetic glass
Wire	7	A14050-9	#18
Wire	2	A30159-69	#22 single shielded
Wire	2	A13876-9	#14
Tubing	2″	A13296-10	0.095″ I.D. Varflex
Tubing	9″	A13296-3	0.118″ I.D. Varflex
Tubing	2″	A13296-6	0.133″ I.D. Varflex

d. LOOP TO COMPASS CABLE CONSTRUCTION.—The loop transmission cable is of special construction with the wires so arranged that the capacity is between 150 and 170 micromicrofarads and the inductance of the two RF wires connected in series is between 2 and 4 microhenries.

Figure 29 shows the construction of the loop transmission cable. This cable contains three wires which must agree with the following description. The black #22 Lenzac wire runs straight through the conduit and is as long as the cable. The white-blue and the white-black wires are #22 Lenz RF wires. These two RF wires are folded back upon themselves until the requirements as to cable length, capacity and inductance is satisfied. The wires are tied or taped together, placed in the cable, and connected to the plug pins.

This cable is available only between the limits of 42 and 168 inches and must not be altered unless the required characteristics of the original can be exactly duplicated.

8. INTERCONNECTION OF COMPONENTS.

All interconnection between the components should be made in the junction box except the connection from the non-directional antenna and the loop to the radio compass, and the mechanical connections.

a. JUNCTION BOX WIRING.—The wiring of the junction box will depend upon the specific installation requirements, and figures 30 and 79 show a typical installation which may be used as a guide for the interconnection of components.

b. CABLE CONNECTIONS.—After wiring the leads of the cables into the junction box, check the wiring from the plugs to the junction box terminals with an ohmmeter. Connect the cables as listed in the following table:

Cable Part No.	*Plug*	*From*		*To*	
		Receptacle	*Component*	*Receptacle*	*Component*
AC58267	P5	..	MS-14	J5	IN-4A
AC58267*	P6*	..	MS-14*	J6*	IN-4A*
AC59728	P4	..	MS 14	J4	MN-26
AC59729	P3	..	MS-14	J3	MN-28

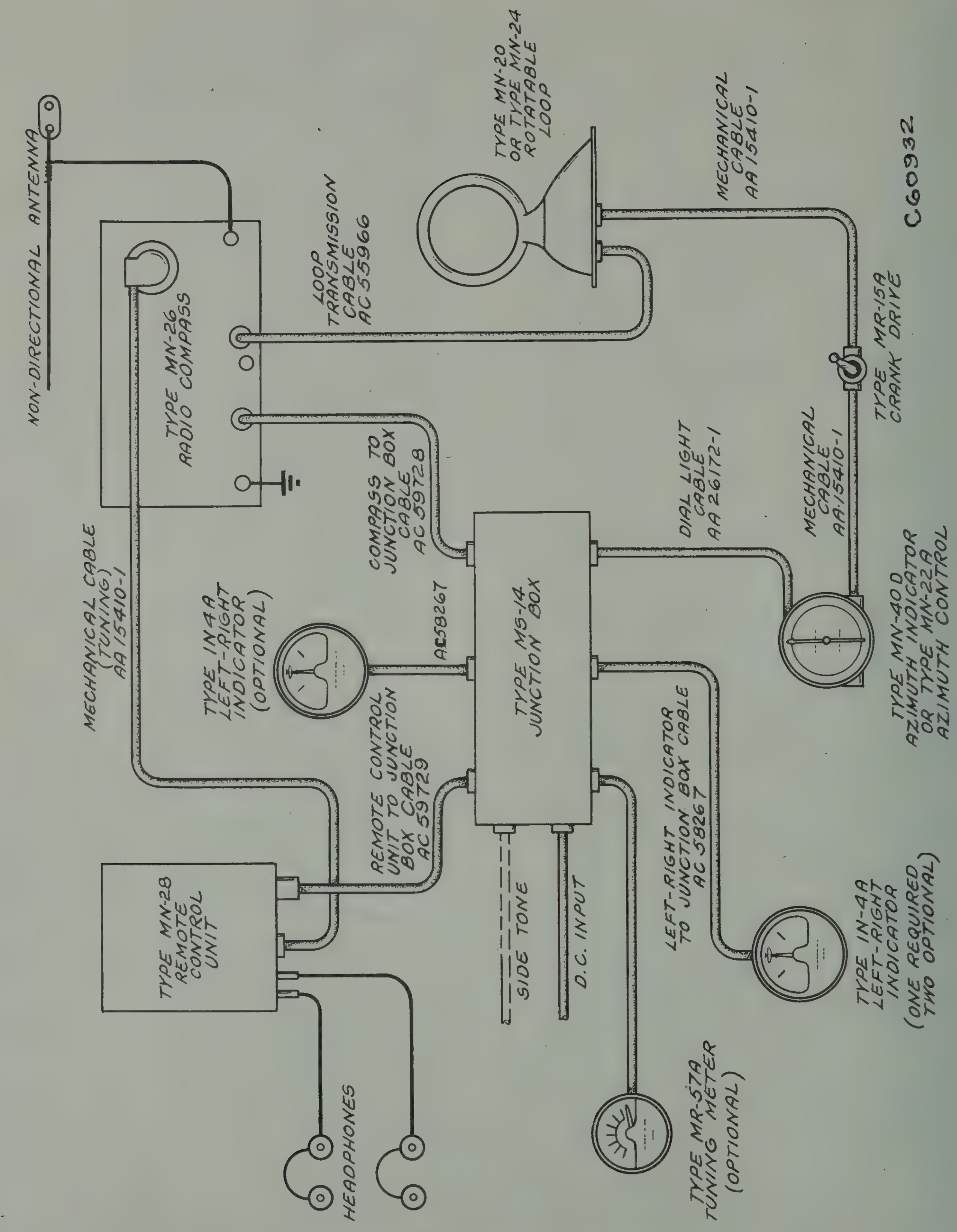


Figure 30 — Typical Cordage Diagram

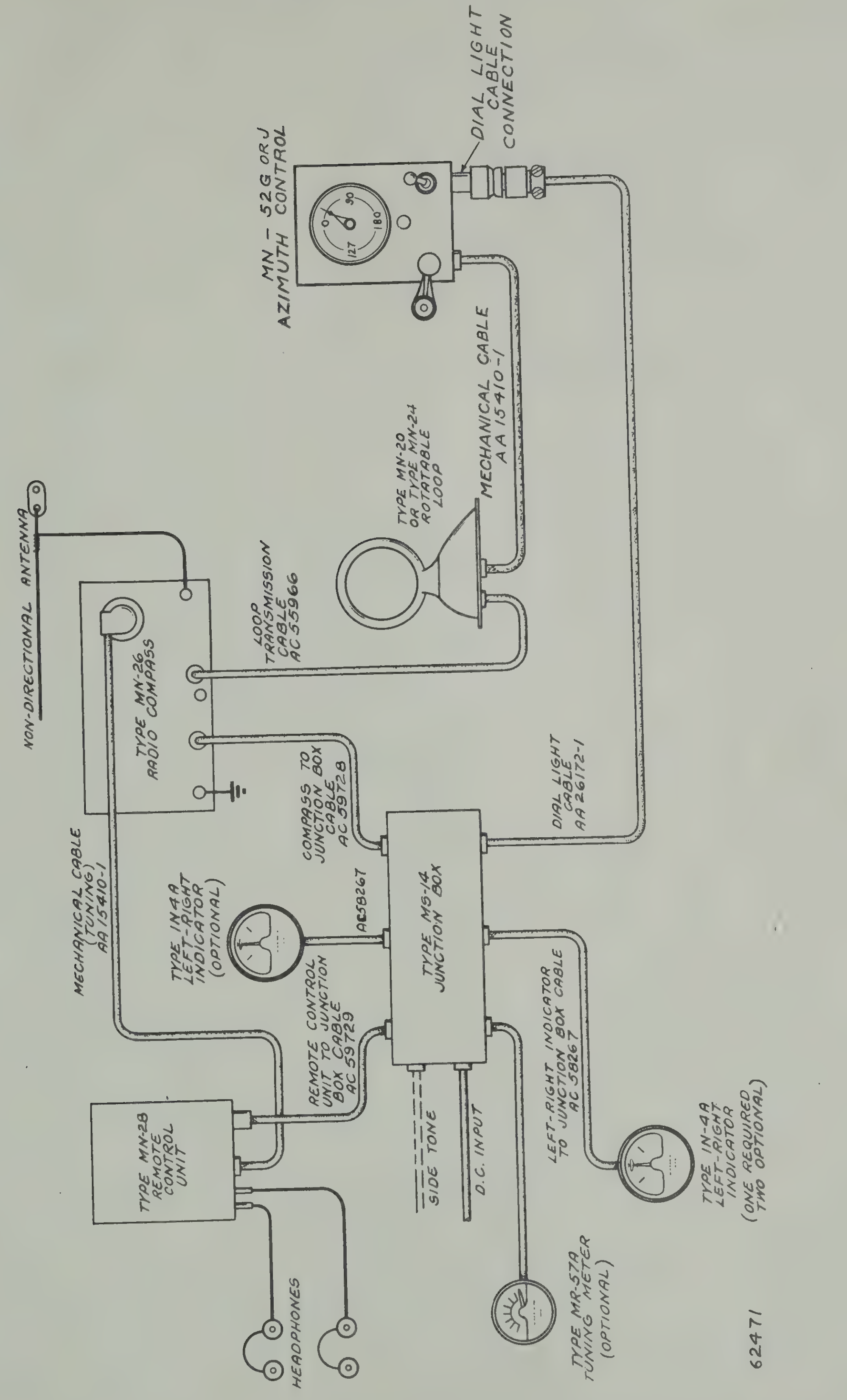


FIGURE 31 — OPTIONAL INSTALLATION, TYPE MN-52G AND MN-52J AZIMUTH CONTROL

Cable Part No.	Plug	From		To	
		Receptacle	Component	Receptacle	Component
+ Battery Cable	..	..	MS-14	+ Terminal	Battery
− Battery Cable	..	..	MS-14	− Terminal	Battery
..	..	..	MS-14†	..	MR-57A†
AA26172-1	..	..	MS 14	..	MN-22A or MN-40D
..	..	..	Ground	GND	MN-26
AC55966	..	J8	MN-20 or MN-24	J7	MN-26
..	P10	..	Antenna	J10	MN-26
AA15410-1	..	..	MN-28	..	MN-26
AA15410-1	..	..	MN-20 or MN-24	..	MN-22A or MN-40D
AA15410-1	..	..	MN-22A or MN-40D	..	MR-15A

* If two Type IN-4A Left-Right Indicators are used.

† If Type MR-57A Tuning Meter is not used, terminal 18 of plug P4 must be connected to terminal 6 of Plug P4. (Make all changes in Junction Box—*not in set*.)

9. TESTS AFTER INSTALLATION.

After the radio compass has been installed in the aircraft, the following tests should be made before placing the equipment into service.

a. Before turning on the radio compass, check the battery voltage and polarity at the remote control. The fuse terminals should be +22 to +30 volts (11 to 15 volts for 14-volt installation) with respect to ground, regardless of engine speed.

b. Check vacuum tubes to ascertain that they are securely seated in their sockets, and that the grid clips and grid shield caps are making positive contact and are not shorting.

c. Test operation of mechanical cables and connections. When properly connected, the ALIGN mark on the remote dial is centered with the ganged condenser at maximum.

d. Check radio compass mounting base screws.

e. Check remote control for tightness of mounting to aircraft structures, and check mounting screws on panel for tightness.

f. Check non-directional antenna and see that connections are properly and securely made.

g. Be sure that the loop transmission cable is supported, taped, and bonded. Check tightness of ferrule couplings on the plugs.

h. Check for presence and operation of instrument lights. Also check lamp controls.

i. Using a headset, check receiver operation on all three bands, then check compass operation and indicator response. Jar the compass unit to check for possible sources of noise.

j. Switch compass on and off and note whether or not the airplane's magnetic compass is affected.

k. Check for effects of other radio equipment in the aircraft upon the communicational and navigational performance of the radio compass. Also determine the extent of any interference produced by the radio compass in other radio equipment.

l. Turn OFF - COMP. - REC.ANT. - REC.LOOP switch (see figure 23) to COMP. and head the plane toward a transmitting station of known direction. The azimuth indicator should be set for 0 azimuth dial reading to give on-course indications on the left-right indicator. Turn the azimuth indicator about 15 degrees to the right of the transmitting station and observe the left-right indicator. The pointer of the left-right indicator should deflect toward the left of the dial. Repeat test, turning the azimuth indicator 15 degrees to the left of the transmitting station. The indicator pointer should deflect to the right of the dial. If the sense indication is wrong, disconnect the mechanical cable from the azimuth control, rotate the azimuth indicator 180 degrees, and again connect the mechanical cable onto the azimuth indicator.

m. With AUDIO control at maximum, tune through each band with the engine stopped and note the noise level. Repeat test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, the aircraft shielding and bombing and the battery circuit filtering should be improved.

10. LOOP GAIN ADJUSTMENT.

The function of the loop gain control R1 is to provide the proper ratio of loop signal to vertical antenna signal. The control is located on the left side of the compass unit chassis (see figure 68). The adjustment procedure is as follows:

a. Take the airplane to a place removed from buildings, power lines, fences, etc. (If the vertical antenna used with the compass unit is installed underneath the fuselage of the aircraft the adjustments should be made

while the aircraft is in flight, as the pick-up of the vertical antenna will be affected by its proximity to ground.)

b. Turn loop gain control fully counterclockwise and set the OFF-COMP.-REC.ANT.-REC.LOOP switch at the COMP. position.

c. Tune in a strong signal and rotate the loop until on-course indication is obtained on the left-right indicator.

d. Rotate loop 90 degrees and "back-off" on the COMPASS control R3 (see figure 3) until a less than full-scale deflection of the left-right indicator is obtained.

e. Turn loop gain control R1 slowly in a clockwise manner until further clockwise adjustment no longer results in increased indicator deflection, readjusting the COMPASS control R3 if necessary to keep the indicator needle within scale limits.

11. THRESHOLD SENSITIVITY ADJUSTMENT.

The threshold sensitivity control R2 is mounted in the remote control unit (see figure 62). After the loop gain control has been adjusted, with the threshold sensitivity control turned fully clockwise, tune the receiver to the point of maximum noise and meter deflection with no signal applied. This should occur in the low frequency band. (This test should be conducted in a location that is as free as possible from interference or static in order that the amount of externally generated noise be at a minimum.) Turn the threshold sensitivity control R2 (see figure 3) counterclockwise until the indicator deflection is not over three-quarters full scale.

12. QUADRANTAL OR AIRCRAFT ERROR CALIBRATION.

a. GENERAL.—It will be necessary to check the direction of radio bearings every 15 degrees from the fore-aft axis of the aircraft in order to determine and compensate the deviations caused by distortion of the radio field pattern due to wings, engines, propellers, antennas, and other parts of the aircraft.

The calibration may be made on the ground for installations in which the loop is on top the airplane; however, for installations with the loop beneath the fuselage, the use of a flight method is necessary if accuracy is to be obtained. Ground methods require more time and more personnel and do not obviate the necessity for checking in the air. Calibration data may be obtained in flight by the following methods.

Aircraft error increases with frequency so that the greatest errors will occur at the highest frequencies used for radio compass operation. Consequently, calibration should be made on at least one station in each band and on frequencies most generally used, where greatest accuracy is required. Accurate bearings may generally be obtained on stations in the frequency range from 200 to 1000 Kcs. The error caused by a change in frequency from 200 to 1000 Kcs. should not usually exceed 3 degrees. When calibration data obtained at the midpoint of this range is used for compensation of the loop, bearings read directly from the azimuth indicator at any other frequency between 200 and 1000 Kcs should not generally be in error by more than 2 degrees. Errors due to sharp discontinuities in the quadrantal error curve will be variable with frequency. These discontinuities are probably caused by resonant structures (usually antennas), and it is important that the loop be so located with respect to such structures that the quadrantal error curve is smooth and essentially sinusoidal.

b. RADIO COMPASS CALIBRATION ON THE GROUND.

(1) General.—The calibration may be made on the ground by one of two methods; either by moving a portable radio transmitter around the aircraft at a distance of at least 1000 feet in a clear and open field, or by using a fixed radio station and turning the aircraft on a compass rose.

Check should be made at 15-degree intervals, or at 10-degree or 5-degree points if greater accuracy is required.

(2) PORTABLE TRANSMITTER METHOD.—The procedure to be followed when a portable radio transmitter is moved around the aircraft is as follows:

(*a*) Locate the aircraft in the center of a clear and open field at least 2000 feet in diameter. The aircraft must be in flying position.

(*b*) Locate a portable transmitter in line with the fore-and-aft axis of the aircraft so that the aircraft heads towards the transmitter. Use an accurate means of alignment such as an engineer's transit, or pelorus, located on top of the aircraft. The portable transmitter should have sufficient power (5 to 100 watts) to override any external interference and should use a vertical rod or mast 10 to 50 feet high for an antenna.

(*c*) Set the transit or pelorus to zero degrees when the line of sight from the pelorus to the transmitter coincides with the center line of the aircraft.

(*d*) Tune the radio compass in the aircraft to the frequency of the portable transmitter. Choose a transmitter frequency free of interfering signals, and preferably in the frequency range that will be used most of the time for radio bearings.

(*e*) Rotate the loop until on-course indication is obtained. The bearing reading of the azimuth indicator should be zero if previous adjustments were made

correctly. Record this reading for the zero heading of the aircraft on a form similar to that shown in figure 34.

(*f*) Move the portable transmitter, at a radius of at least 1000 feet, through an angle of 15 degrees with respect to the axis of the aircraft, as determined by the line of sight of the transit or pelorus mounted on the aircraft. Rotate the loop until on-course indication is obtained on the left-right indicator. Note and record the reading of the azimuth indicator for the 15-degree position of the transmitter.

(*g*) Move the transmitter 15 degrees from its position in section II, paragraph 12 *b*(2) (*f*) above at a radius of at least 1000 feet so that the line of sight from the aircraft to the transmitter makes an angle of 30 degrees with the axis of the aircraft. Rotate the loop until on-course indication is obtained. Note and record the reading of the azimuth indicator for the 30-degree position of the transmitter.

(*h*) Repeat the above procedure for transmitter positions at 15-degree (or less) intervals until the transmitter has been moved through 360 degrees around the aircraft.

(*i*) Plot a correction curve of the results obtained on the graph sheet as described in section II, paragraph 13 *a*(1).

(*j*) Repeat the calibration for different frequencies. Be sure to indicate the calibrating frequency on each calibration curve obtained.

(3) FIXED TRANSMITTER METHOD.—Calibration of the equipment on the ground from a fixed radio station may be made at the same time the magnetic compass is calibrated and may be accomplished as follows:

(*a*) Locate the aircraft on a compass rose. The aircraft must be in flying position. The general location should be clear of all buildings or obstructions. If a compass rose is not available, one accurate heading toward the selected radio station must be determined and means provided for measuring the angle of aircraft heading with respect to the radio station heading. This angle may be measured by using a transit or pelorus set up on top of the aircraft and sighting on some fixed object at least 1000 feet distant from the aircraft.

(*b*) Select a high-powered, clear-channel radio station from 10 to 100 miles distant, or use a suitable portable transmitter as described for the preceding method. The station should normally provide good bearings with practically no fluctuation of the left-right indicator needle.

(*c*) Tune the radio compass receiver to the transmitter frequency used, and accurately head the aircraft toward the transmitter. Rotate the loop for an on-course indication on the left-right indicator needle. Set the azimuth scale zero mark on the azimuth indicator to the zero index mark. Note and record the pointer reading of the azimuth indicator for the zero-degree heading of the aircraft. The azimuth indicator reading should be zero degrees if the installation and all adjustments have been made correctly.

(*d*) Swing the heading of the aircraft through an angle of 15 degrees (or less) from the original zero heading above. Rotate the loop for an on-course indication. Note and record the bearing reading of the azimuth indicator. Reading should increase.

(*e*) Increase the heading of the aircraft by 15 degrees so that a heading of 30 degrees with respect to the original zero heading is established. Rotate the loop for an on-course indication. Note and record the pointer reading of the azimuth indicator.

(*f*) Repeat the above procedure for every 15-degree increase in heading of the aircraft until the aircraft has been turned through 360 degrees.

(*g*) Plot a correction curve of the results obtained on the graph sheet as described in section II, paragraph 13*a*(1).

(*h*) Repeat the calibration for different frequencies. Be sure to indicate the calibrating frequency on each calibration curve obtained.

c. RADIO COMPASS CALIBRATION IN THE AIR.

(1) GROUND REFERENCE—LINE METHOD.—Calibration may be accomplished in the air as follows:

(*a*) Select a medium or high powered radio station between 25 and 100 miles distant from the locale at which the test is to be conducted. The radio station selected should not be in a congested channel where high powered adjacent channel signals can, by slight-mistuning, cause bearing errors. The station should normally provide good bearings with little or no fluctuation of the compass indicator needle.

(*b*) Select a day when the wind is less than eight miles per hour in order to avoid excessive drift angles, and when the air is smooth in order to avoid errors in reading the bearing angles. Do not make the calibration within one hour of sunrise or sunset or when wide fluctuations of bearings are noted.

(*c*) At some time prior to take-off, rotate the Type MN-40D Azimuth Indicator, or the Type MN-22A Azimuth Control (whichever is used) to see that there is no correction set up on the instrument. Turn the pointer of the Type MN-40D Azimuth Indicator, or the Type MN-22A Azimuth Control (whichever is used) by means of Type MR-15A to successive 15-degree positions of the inner dial scale (as seen through the small window beneath the word "RADIO COMPASS"), and see that the indicated bearings correspond

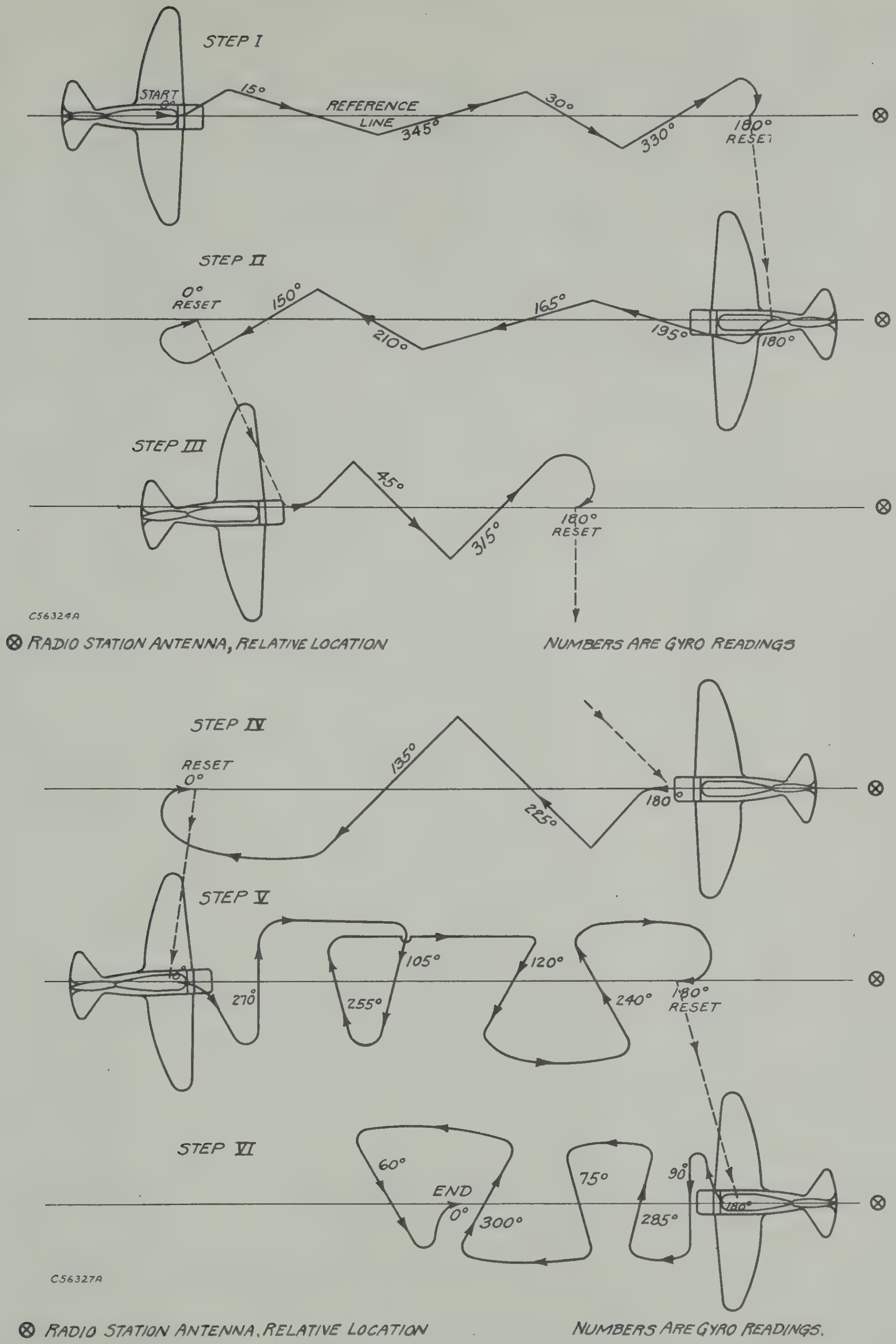


FIGURE 32 — QUADRANTAL ERROR CALIBRATION FLIGHT PATTERN

to these inner dial readings. The outer dial zero should be at the index mark, and care should be taken not to move the "VAR." knob during this check.

(*d*) Select a landmark or series of landmarks (such as a road, railroad track, section lines, etc.) which will provide a direct line toward the radio station. Since power lines or railroads on or adjacent to the landmark can distort the radio path, a check should be made to determine whether or not distortion is present. This can be done by crossing the power line at various angles while maintaining fixed courses by means of the directional gyro. If the bearing changes rapidly as the line is approached, distortion is present and should be eliminated by flying at a greater elevation, or by selecting a new reference landmark.

(*e*) With the aircraft in level flight, fly along this reference line at an altitude low enough to avoid parallax error. If the airplane has a drift meter installed, it can be used to insure that the direction of flight is parallel to, or directly over, the reference line. Set the directional gyro to zero, and rotate the loop to obtain "On Course" indication on the Type IN-4A Left-Right Indicator. When passing over some predetermined point or intersecting line to the reference, record simultaneously the bearing indicator reading and the directional gyro reading. Also record the drift meter reading if a drift meter is being used. The above readings, if the previous setting and the line of flight have been maintained, should be zero. This maneuver, as well as those discussed in the following paragraphs are indicated by figure 32. In practice, it will be found practicable to have the co-pilot use figure 32 to direct the pilot and to maintain the airplane's location at all times with respect to the flight pattern shown.

(*f*) Turn the aircraft to the left, and then swing back to the right, crossing the reference line at an angle of 15 degrees by the directional gyro. The pilot should be instructed to swing far enough out on these maneuvers to regain level flight some distance before the reference line is reached. Readings should be made only during conditions of level flight. Have the pilot inform the radio compass operator at the instant the airplane crosses the reference line. Record the radio compass bearing for that instant in the indicated place in column 3 on figure 80. For those installations having a drift meter, greater accuracy can be obtained since the drift meter observer can determine the exact moment of crossing the reference and can read the heading at that exact flight position.

(*g*) Repeat the above procedure throughout Step I of figure 27, recording the data in the third column of figure 80; return on the reference line as shown in step II. The directional gyro should be reset each time a new step is begun.

(*h*) Repeat the above procedure until the entire flight pattern of figure 27 has been flown.

(*i*) During the above procedure, care must be taken to avoid parallax in reading the instruments, and to set the directional gyro accurately. One or two check runs should be made if best accuracy is to be obtained.

(*j*) Calibration data obtained for a particular type of airplane is usable without modification for all airplanes of that type, if the location of the loop and other antennas is the same. Since all airplanes of the same type may not have the same radio installations, an accurate diagram with antenna dimensions and exact loop location will add to the usefulness of the recorded data (figure 80).

> NOTE: Since radio compass deviation changes to some extent with frequency, calibration data should be taken at several frequencies to insure greatest accuracy in use. The readings used to set up the radio compass deviation compensators on the indicators should be those obtained at some frequency between 200 kcs and 1000 kcs, since in that frequency range the radio wave characteristics are better suited to radio compass use. Under service conditions, and with the bearing indicator properly compensated, the overall radio compass deviation should not exceed three degrees except at points of large rate of change of error between 15 degree rhumb lines or sectors.

(2) FLIGHT CALIBRATION FROM TWO OPPOSITE 360-DEGREE TURNS.

(*a*) Coincidence of the zero-degree radio bearing with the zero-degree heading of the aircraft must be checked prior to the use of this procedure. This may be checked on the ground in accordance with section II, paragraph 12*b*(2) or 12*b*(3) and then checked in the air by the following method:

1. Head the aircraft toward a transmitter having a vertical radiator that is clearly visible from all angles of approach. Fly directly into or with the existing winds to eliminate drift if a location and period free from winds is not available.

2. Tune the radio compass to the transmitter, and set the zero mark of the bearing indicator azimuth scale to the zero index.

3. Align the fore-and-aft axis of the aircraft with a radial line from the transmitting antenna as accurately as possible. Do not rely on visual heading checks from the cockpit, since considerable error due to parallax may result. The use of a telescopic cross-hair

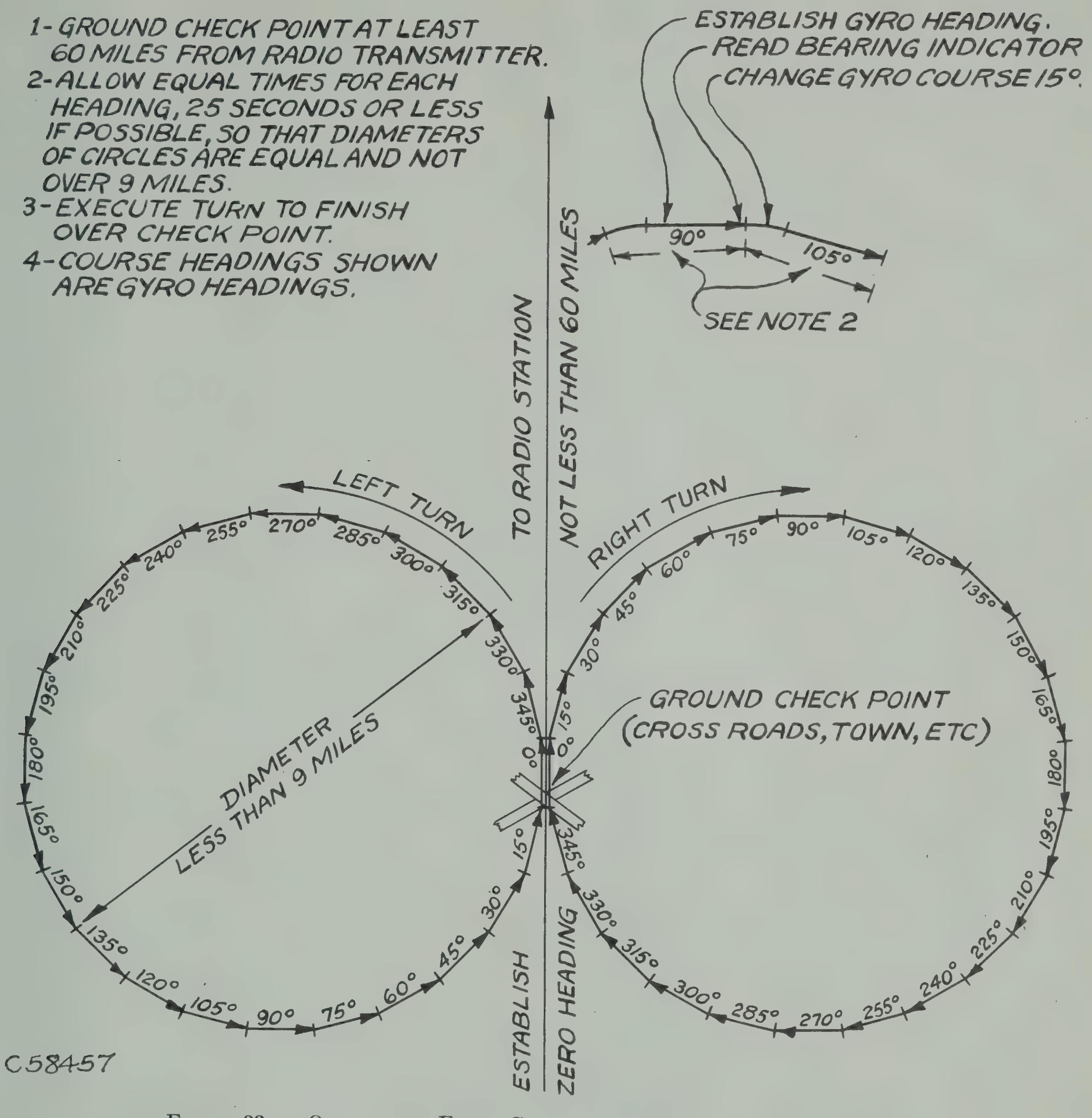


FIGURE 33 — QUADRANTAL ERROR CALIBRATION TWO-CIRCLE FLIGHT PATTERN

sight mounted in the cockpit and accurately aligned with the axis of the aircraft is recommended. If such equipment is not available, the heading may be aligned by sighting along the aircraft center line from the rear center of the cabin through the center of the windshield. Direct the pilot to change the heading until the fore-and aft axis of the aircraft coincides with a line from the transmitter. Alignment observation should be made along the center line of the aircraft as far aft as possible from the center of the windshield in order to increase the accuracy of alignment. A two-inch deviation to the right or left from the center of the aircraft at a distance of ten feet from the center vertical line of the windshield corresponds to an angle of one degree.

4. While the aircraft is held in level flight and headed directly toward the transmitting antenna,

rotate the crank drive (with azimuth indicator near 0) until on course is registered by the left-right indicator. The bearing indicator should read 0 ± 2 degrees if all adjustments have been correctly made.

5. Repeat the above procedure at least once, approaching the transmitter from the opposite direction, to check the first reading.

6. Record the bearing indicator reading obtained for the zero heading of the aircraft.

7. The 180-degree radio bearing may be checked by holding the above-established course and flying over and past the transmitting antenna far enough to obtain steady indications.

(*b*) After the zero bearing has been checked, a calibration flight procedure similar to that shown in figure 33 should be followed. Briefly, the procedure is to obtain bearing indicator readings for every 15-degree (or less) change in gyro heading of the aircraft during two 360-degree turns of equal diameter. The turns are made in opposite directions and started and finished over a given point on the ground. The lengths of all 15-degree courses should be equal so that a circle is approximated. Two bearing indicator readings will be obtained for a given gyro reading after the two turns have been completed (one for each turn). The average of these two indicator readings is used in determining the compensator corrections.

(*c*) Locate a suitable ground check point, such as a road intersection or small town not less than 60 miles from the radio station to be used. The station should provide good bearings with little or no fluctuation of the bearing indicator in the vicinity of the ground check point. Approach the ground check point from the side opposite the transmitter so that the aircraft heads directly toward the transmitter. Use the radio bearing indicator to establish this heading by orienting the aircraft until a radio bearing of zero degrees is obtained. If results of the zero-heading check of paragraph A above indicate that the zero heading of the aircraft does not coincide with the zero radio bearing (within ± 2 degrees), orient the aircraft so that the zero-heading radio bearing obtained in section II, paragraph 12*c*(2) (a) above is indicated.

(*d*) With the aircraft in steady, level flight and on a heading of zero degrees with respect to the transmitter, set the directional gyro to zero. Hold this course and release the gyro caging knob before the ground check point is reached. The radio bearing indicator reading must be zero or the same reading obtained in paragraph *a* above, when the aircraft is directly over the ground check point.

(*e*) Change the heading of the aircraft by a smooth and even turn to establish a gyro heading of 345 degrees. After a steady 345-degree heading has been attained with the aircraft in level flight, note and record the radio bearing indicator reading on a chart similar to that shown in figure 80. Not more than 20 to 25 seconds should be required for each heading after several trial headings have been made.

(*f*) Decrease the gyro heading of the aircraft from 345 to 330 degrees by a smooth turn. Rotate and record the radio bearing indicator reading after a steady and level heading has been established and just before the turn is started for the next gyro heading of 315 degrees.

(*g*) Continue in this manner to obtain bearing of the indicator readings for each 15-degree change in gyro heading of the aircraft, always establishing steady course and level flight conditions before the bearing indicator is read. Record the readings for each course on a form similar to figure 80.

(*h*) The finish of the 15-degree gyro course should bring the aircraft directly over the ground check point if the complete left turn has been properly executed. After the radio bearing has been obtained for a 15-degree gyro heading, turn the aircraft for a zero-degree radio bearing (or the radio bearing noted in paragraph *a* above). The aircraft should now be flying on the original starting line over the ground check point and headed directly toward the transmitter. Note and record the gyro reading for this heading of the aircraft. The gyro should check its original setting within 2 to 3 degrees if all turns have been carefully made.

(*i*) If the gyro reading checks with its original zero setting when the aircraft is over the ground check point and headed directly toward the transmitter, as indicated by the radio bearing indicator, make a right turn to establish a gyro heading of 15 degrees, thus beginning the second half of the calibration procedure. If the gyro reading does not check its original setting, establish a zero reference course, as mentioned in section II, paragraph 12*c*(2)(*c*) and 12*c*(2)(*d*) above.

(*j*) Obtain radio bearing indicator readings for every 15-degree change in gyro heading of the aircraft following the same procedure given above, making a series of right turns instead of left turns. Execute the complete 360-degree right turn so that the diameters of the two circles approximated during the left and right turns are as nearly equal as possible. Record the data obtained on a form similar to figure 80.

(*k*) Take the average of each pair of radio bearing indicator readings for a given gyro heading. These averages are to be used for obtaining the corrections to be applied at 15-degree intervals on the loop compensator unit.

(*l*) The accuracy of this calibration procedure depends on the diameter of the two circles and the dis-

STATION USED CW FREQ. 400 Kcs.

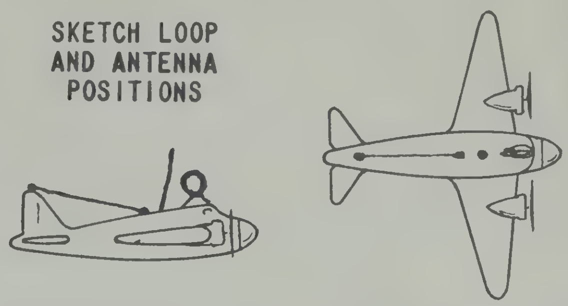
PLANE NO. NC 6583 PILOT J. Doe

RECORDER G.O.E. DATE 10-30-43

REF. MARK QUAD. POSITION 0° ✓ 90° ____ 180° ____ 270° ____

LOCATION U.S. highway #75 between Centerville and Laketown

SKETCH LOOP AND ANTENNA POSITIONS



GYRO HEADING	PLANE TO RADIO STATION BEARING (TRUE RADIO BEARING)	OBSERVED RADIO BEARING (INDICATED ON MN-22A OR MN-40D)	BEARING CORRECTION (COLUMN 2 MINUS COLUMN 3)
COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
0	0	0	0
15	345	350	-5
345	15	10	+5
30	330	339	-9
330	30	22	+8
180	180	180	0
195	165	170	-5
165	195	190	+5
210	150	159	-9
150	210	201	+9
0	0	0	0
45	315	326	-11
315	45	35	+10
60	300	310	-10
300	60	50	+10
180	180	180	0
225	135	146	-11
135	225	214	+11
240	120	131	-11
120	240	229	+11
0	0	0	0
75	285	291	-6
285	75	68	+7
90	270	270	0
270	90	90	0
180	180	180	0
255	105	112	-7
105	255	248	+7
180	180	180	0

CAM SCALE (OF MN-22A) OR INNER SCALE OF MN-40D	CAM CORRECTION FOR MN-22A (FROM CURVE)	OUTER SCALE OF MN-40D (COLUMN 5 PLUS COLUMN 6)
COLUMN 5	COLUMN 6	COLUMN 7
0	0.0	0.0
15	+7.0	22.0
345	-7.5	337.5
30	+9.5	39.5
330	-10.5	319.5
45	+10.5	55.5
315	-10.5	304.5
60	+9.0	69.0
300	-8.0	292.0
75	+5.0	80.0
285	-4.0	281.0
90	+0.0	90.0
270	+0.0	270.0
105	-5.0	100.0
255	+5.0	260.0
120	-9.0	111.0
240	+9.0	249.0
135	-11.5	123.5
225	+11.5	236.5
150	-10.5	139.5
210	+10.5	220.5
165	-7.0	158.0
195	+7.0	202.0
180	+0.0	180.0

EXAMPLE ONLY

DO NOT USE

5893

Figure 34 — Sample Quadrantal Error Data Sheet

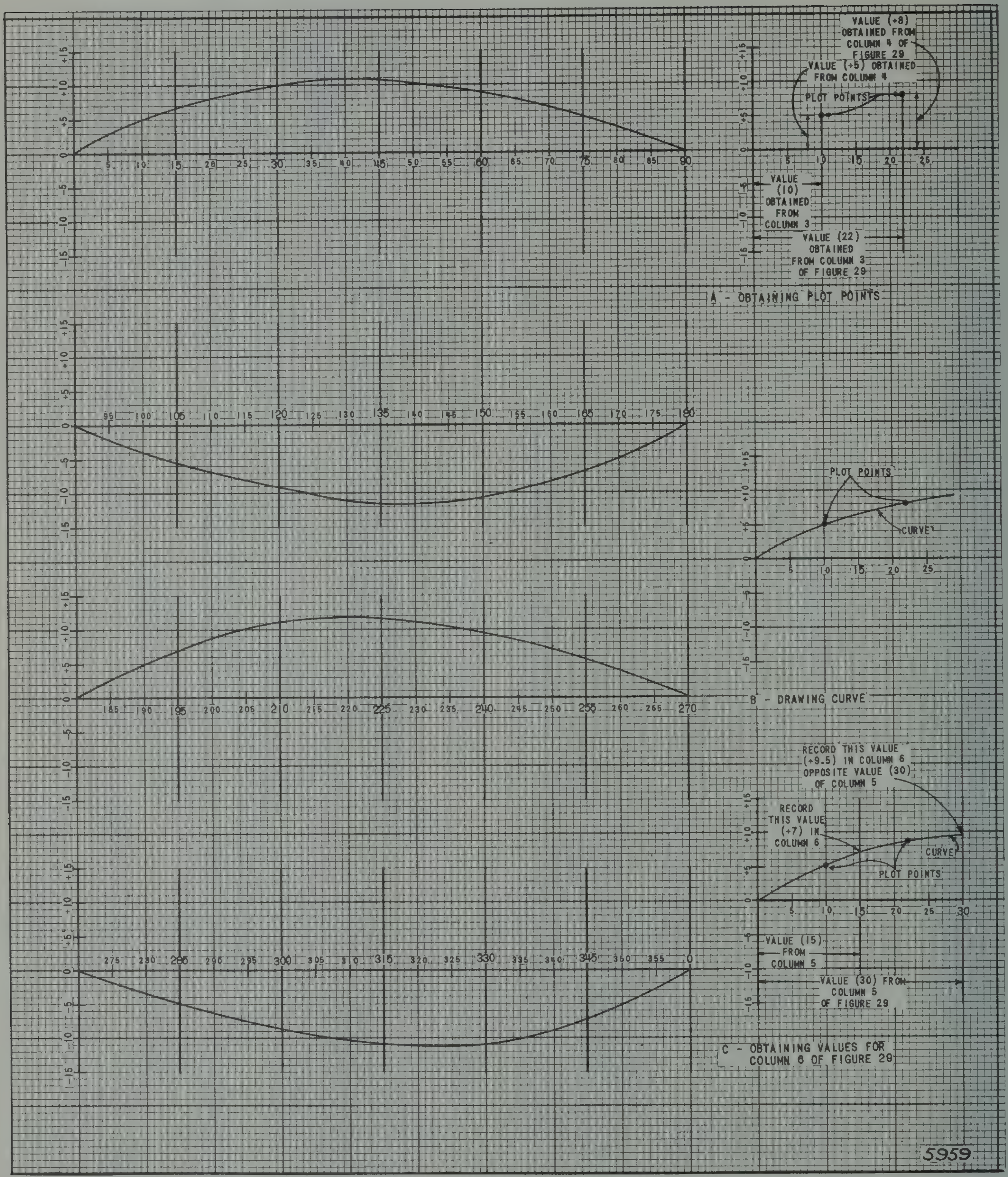
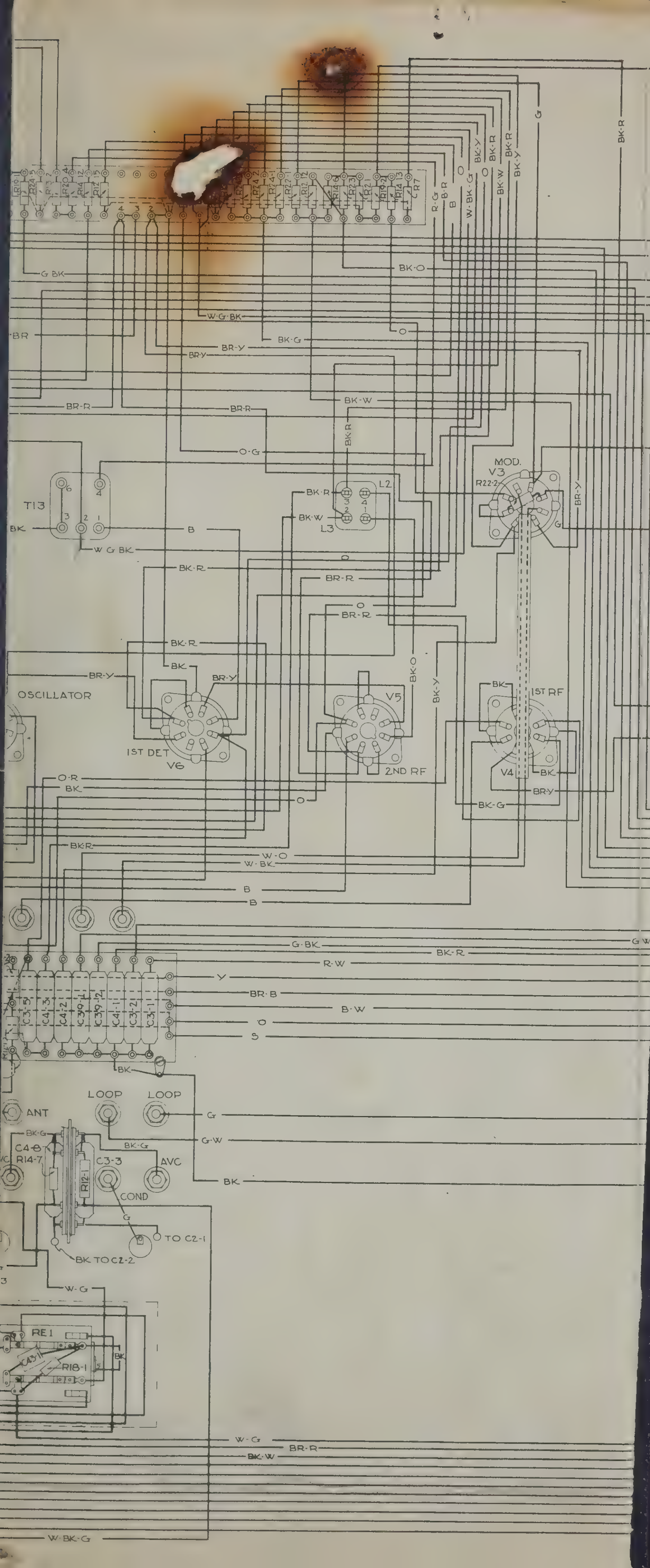


FIGURE 35 — SAMPLE QUADRANTAL ERROR CALIBRATION CURVE



OSCILLATOR
1ST DET
V6
V5
2ND RF
MOD.
V3
R22-2
1ST RF
V4
T13
L2
L3
LOOP
LOOP
ANT
AVC
C4-8
R14-7
C3-3
R12-1
COND
TO C2-1
BK TO C2-2
RE1
C43-1
R18-1
BK-R
BK-O
BK-W
BK-G
BK-Y
BR-R
BR-Y
W-G-BK
O-G
O-R
W-O
W-BK
G-BK
R-W
BR-B
B-W
G-W
W-G
W-BK-G

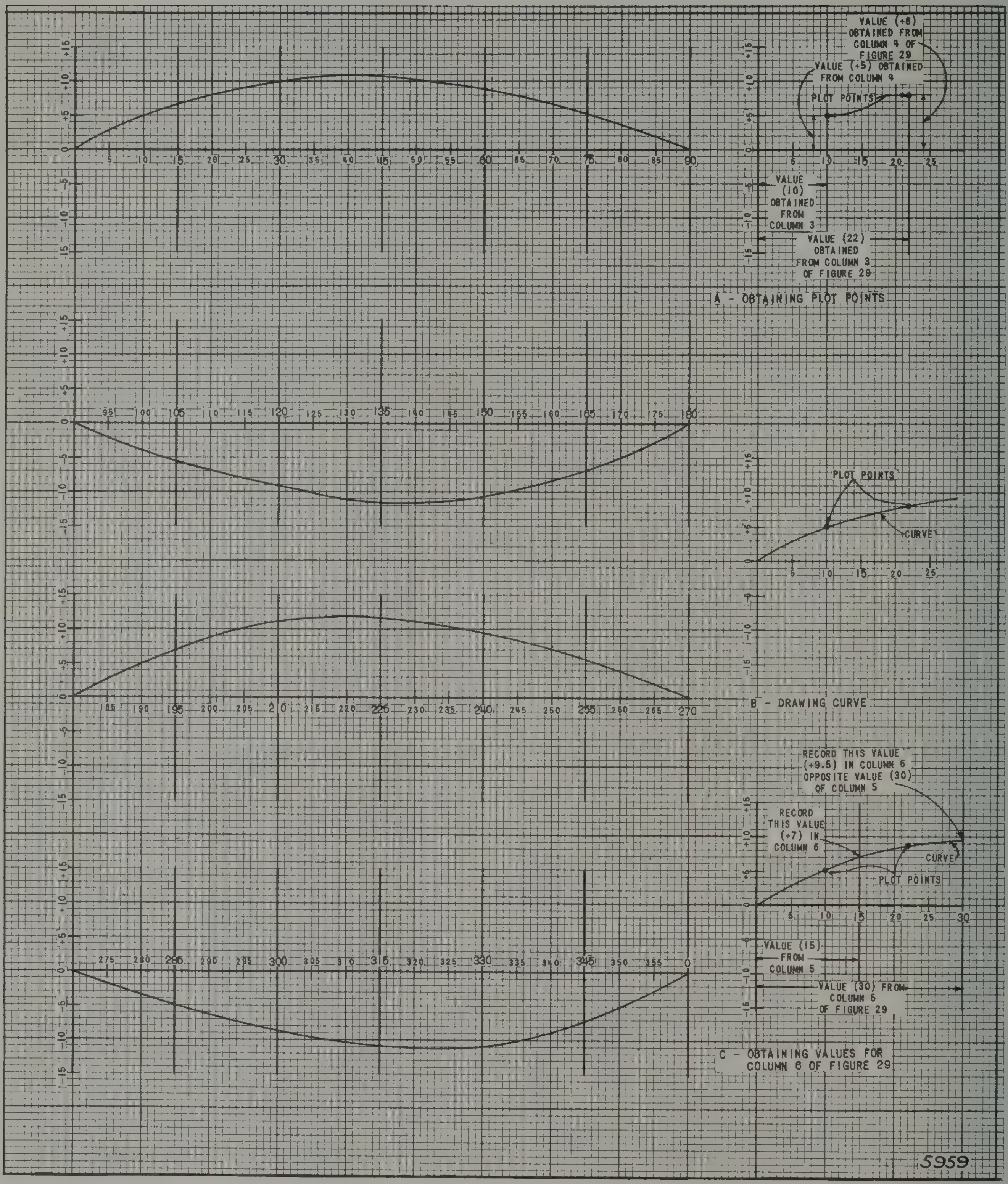


FIGURE 35 — SAMPLE QUADRANTAL ERROR CALIBRATION CURVE

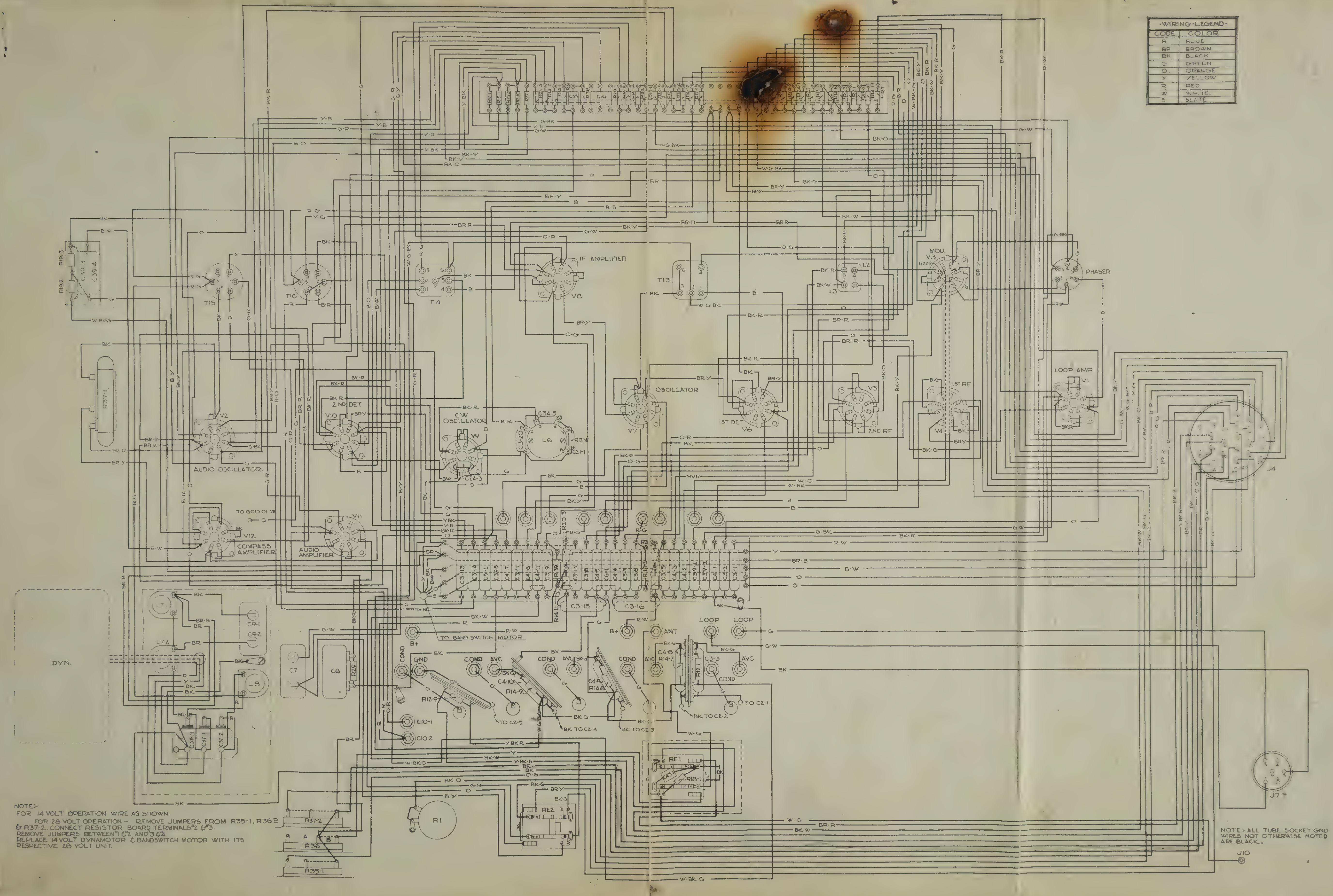
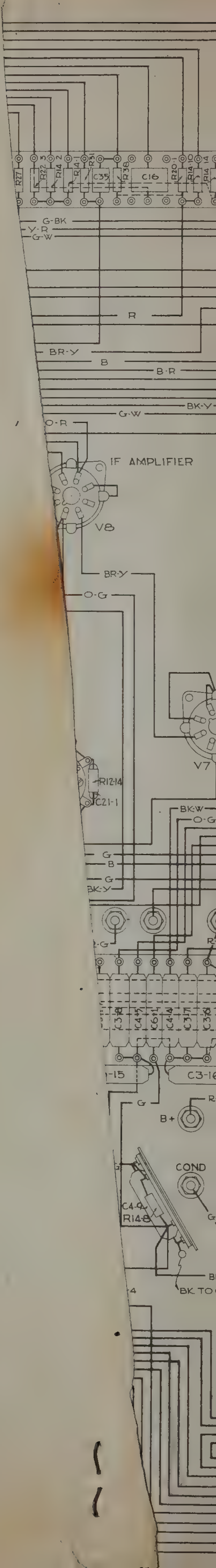


FIGURE 31—TYPE MN-26H RADIO COMPASS, WIRING DIAGRAM



R27
R22
R14
R41
R31
C35
R38
C16
R20
G-BK
Y-R
G-W
R
BR-Y
B
B-R
BK-Y
G-W
O-R
IF AMPLIFIER
V8
BR-Y
O-G
V7
R12-14
C21-1
BK-W
O-G
G
B
G
BK-Y
C3-16
B+
COND
C4-4
R14-8
BK TO

tance of the ground check point from the radio station if other errors due to flight conditions and observational errors are neglected. The ground check point should be as remote as possible from the radio station, consistent with good radio bearing indications, and the diameter of the two circles should be equal and as small as possible. For example, a maximum error of 0.5 degree is introduced on some courses if the ground check point is 90 miles from the radio station and the two circles are 8.5 miles in diameter. This error would be increased to approximately 2.0 degrees for a distance of 30 miles and circle diameters of 8.5 miles. Hence it is recommended that the ground check point be at least 60 miles from the radio station, and that the diameters of the circles be less than 9 miles.

13. AZIMUTH INDICATOR COMPENSATION.

a. TYPE MN-40D ADJUSTMENT.—After the radio compass deviation has been determined in accordance with section II, paragraph 12, it may be compensated in the Type MN-40D Azimuth Indicator so that correct bearings may be read directly from the bearing pointer. Although the corrections can be compensated by direct reference to the observed data, it is more practicable, because of the design of the bearing indicator compensator, to plot the data and interpolate on the curve, thereby obtaining values which apply to the location of the cam roller at the adjustment screw positions throughout the sequence of adjustment.

(1) DETERMINATION OF CORRECTION DATA.

(*a*) Find the differences between the values listed in column 2 and column 3 and record these values in column 4 of figure 80. Where column 2 is *larger* than column 3, place a *plus* (+) sign in front of the value in column 4, and where column 2 is *smaller* than column 3, place a *minus* (−) sign in front of the value in column 4. An example is given below and in figure 29.

Plane to Radio Station Bearing (True Radio Bearing)	*Observed Radio Bearing (Indicated on MN-22A or MN-40D)*	*Bearing Correction (Column 2 Minus Column 3)*
COLUMN 2	COLUMN 3	COLUMN 4
0	0	0
345	350	−5*
15	10	+5†
330	339	−9
30	21	+9

* Column 2 is smaller than column 3 by 5; therefore a −5 is placed in column 4 (345 − 350 = −5).

† Column 2 is larger than column 3 by 5, therefore a +5 is placed in column 4 (15 − 10 = +5).

Complete column 4 of figure 80 in this manner, then plot these values on the graph of figure 81.

(*b*) Locate plot points on the graph of figure 81 from the values in column 3 and column 4 of figure 80. The values in column 3 are located on the horizontal axis (four lines running across the page). The values in column 4 are located by counting up (for + values) or down (for − values) from the horizontal axis. An example is given in "A" of figure 35.

After all the plot points are located on the graph for all the values of column 3 and column 4, a line is drawn through these plot points to form a smooth curve. An example is given in "B" of figure 35 and the completed curve obtained from column 3 and column 4 of figure 34 is plotted on figure 35.

(*c*) Determine the values in column 6 for each of the values listed in column 5 of figure 80 from the curve of figure 81. The 15-degree values of column 5 are heavy vertical lines along the horizontal axis of figure 81 and the values for column 6 are found at the point where the curve crosses the vertical 15-degree marks. An example is given in "C" of figure 35.

(*d*) In order to determine the proper sequence in which the adjusting screws should be set, it is first necessary to know the desired quadrature position of the reverence mark face plate required for the particular airplane installation. This may be determined by observation. Rotate the knob until the zero-degree point is aligned with the desired new position of the reference mark. The degree point (90, 180 and 270 degrees) which falls at the original position of the reference mark on the face plate should be noted and entered at the top of column 4. Adjustment of the compensators *must* progress both clockwise and counterclockwise from the *original* zero position using the data as applicable for that position and referred to the above outer scale values as set by the knob. This is necessary because the cam strip is anchored at that point and the open ends are 180 degrees from that position.

(*e*) Find the values for column 7 by algebraically adding column 5 and column 6. An example is given below and in figure 34.

Cam Scale of MN-22A or Inner Scale of MN-40D	*Cam Correction for MN-22A (from Curve)*	*Outer Scale of MN-40D (Column 5 plus Column 6)*
COLUMN 5	COLUMN 6	COLUMN 7
0	0.0	0.0
15	+7.0	22.0*
345	−7.5	337.5†
30	+9.5	39.5
330	−10.5	319.5

* 15 + 7.0 = 22.0.

† 345 − 7.5 = 337.5.

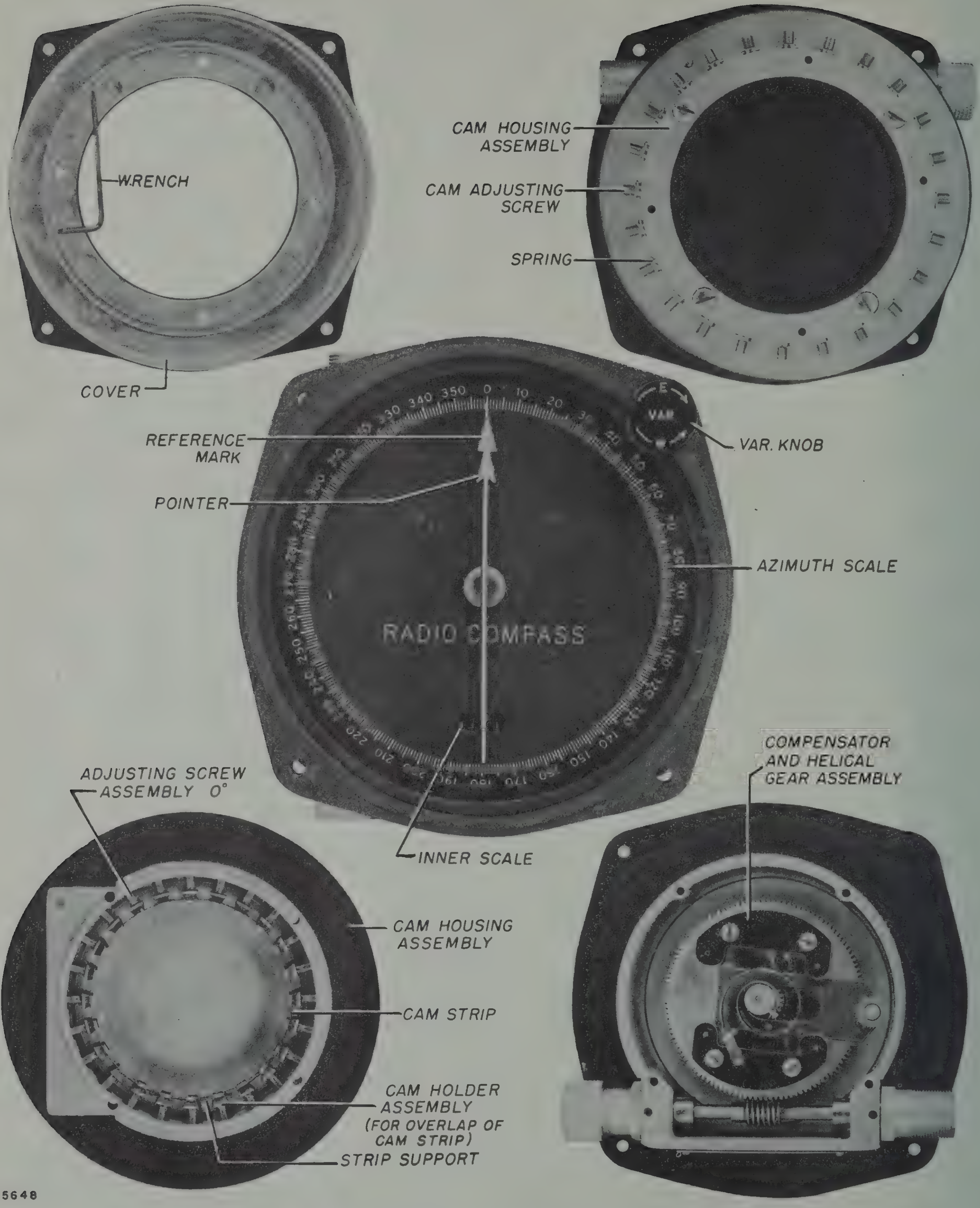


Figure 36 — Type MN-40D Azimuth Indicator, Disassembly

(2) ADJUSTMENT OF THE COMPENSATOR SCREWS OF TYPE MN-40D AZIMUTH INDICATOR (see figure 31).

(*a*) Prior to removing the bearing indicator from the airplane, rotate the pointer to zero index, and uncouple the tuning shaft from its fitting.

(*b*) Unscrew the bearing indicator from its mounting, and take it to a bench or table. Remove the four screws located on the underside, and remove the bottom cover plate. This exposes the adjustment screws (see figure 36).

(*c*) With the reference mark in the original zero position, rotate the azimuth scale by means of the knob (see figure 36) until the degree-setting recorded at the head of column 5, figure 80, is in line with the reference mark. If the setting recorded at the head of column 5, figure 80, is 90, 180, or 270 degrees, the reference mark face-plate should be removed and turned to the new quadrature position determined in section II, paragraph 13 *a* (1) (*d*). To move the plate, remove the snap ring and cover glass, then take out the four small retaining screws on the instrument face. With the knob still set as outlined above, rotate the plate until the reference mark is aligned with zero degrees on the azimuth scale. Replace the screws, being careful to centrally locate the plate so that it does not rub the outer scale when that scale is rotated by the "VAR." knob.

(*d*) Set the inner dial (viewed through the small window of the instrument face below "RADIO COMPASS") to the degree marking which corresponds to that at the head of column 4, and, using the wrench located in the bottom of the bearing indicator, (see figure 36) adjust the compensator screw corresponding to the particular 15-degree setting of column 5, until the pointer reads the correct value as indicated in column 7, figure 80. At all times care must be taken to maintain the zero of the outer dial at the new setting of the reference mark.

(*e*) The above procedure should be followed for each of the 24 compensating screw positions taken in the order listed in column 5, figure 80, (i.e. working alternately clockwise and counterclockwise from the starting position). The adjustment of the compensator screws must progress through alternate clockwise and counterclockwise 15-degree positions from the *original* reference mark position because the cam strip is anchored at the position of the original reference mark and the open ends are 180 degrees from that position. Since the data in columns 5 and 7, figure 80, has been compiled with reference to the *new* position of the reference mark face plate, the corrections can now be applied in accordance with the above adjustment procedure.

(*f*) If large errors are to be corrected, or the rate of change of error per 15-degree sector is rapid, it may be more accurate to set up from $\frac{1}{3}$ to $\frac{1}{2}$ the required correction for all screws; then repeat the entire process once or twice until all screws have been satisfactorily adjusted.

(*g*) Replace the setscrew wrench, and reassemble the bearing indicator.

(*h*) Check the entire applied correction to ascertain that the compensation is correctly set-up.

(*i*) Rotate the pointer to the index mark, and mount the bearing indicator in place in the airplane.

(*j*) Reconnect the tuning shaft to the proper bearing indicator spline.

(3) FLIGHT CHECK.

(*a*) Fly all, or selected portions, of the original course and record the data as per paragraph 12*c*.

(*b*) The bearing indicator pointer reading, with the scale set for zero index, should agree with the figures of column 2 of figure 80, within ±3 degrees for each 15-degree interval directional gyro heading.

(4) RECOMMENDED PRELIMINARY INSTRUCTION.—To obtain a practical knowledge of the above method of plotting the deviation curve and adjusting the compensators, it is recommended that the instructions of section II, paragraph 13*a* be used in conjunction with figure 34 and 35 to set up a sample Type MN-40D Azimuth Indicator.

b. TYPE MN-22A CAM SHAPING (see figure 37).—If a Type MN-22A Azimuth Control is used, the cam must be cut so that corrected bearings may be read directly from the dial. Since the cam is cut for one frequency only, it should provide correction at the most generally used frequency. In most instances the errors will hold to within one or two degrees over the frequency range of 150 to 1500 kcs.

(1) Before cutting the cam, prepare correction data as described in section II, paragraphs 13*a* (1) (*a*) to 13*a* (1) (*d*) inclusive.

(2) Disassemble the cam assembly as follows:

NOTE

Before uncoupling the loop tachshaft, preparatory to removing the azimuth control, set the pointer on zero. Make sure that the shafting does not rotate from this position during the time in which the azimuth control is uncoupled.

(*a*) Remove the back cover by unfastening the six screws.

(*b*) Remove the cam supporting bracket.

(*c*) Unscrew the cam holding nut and remove the cam blank from the cam bracket.

(3) The azimuthal bearings of the loop (column 5 of figure 80) are indicated on the cam blank by the

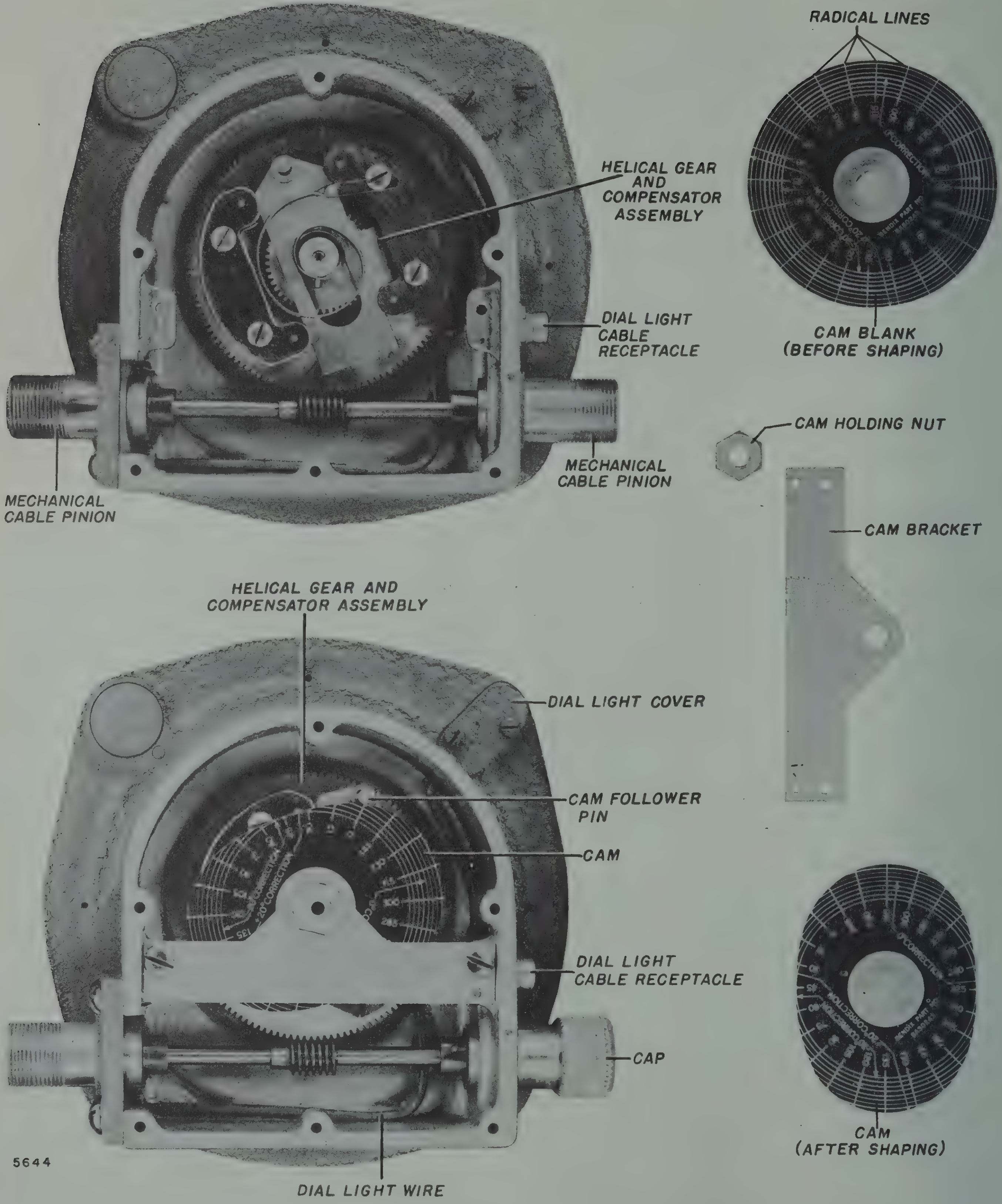


FIGURE 37 — TYPE MN-22A AZIMUTH INDICATOR, DISASSEMBLY

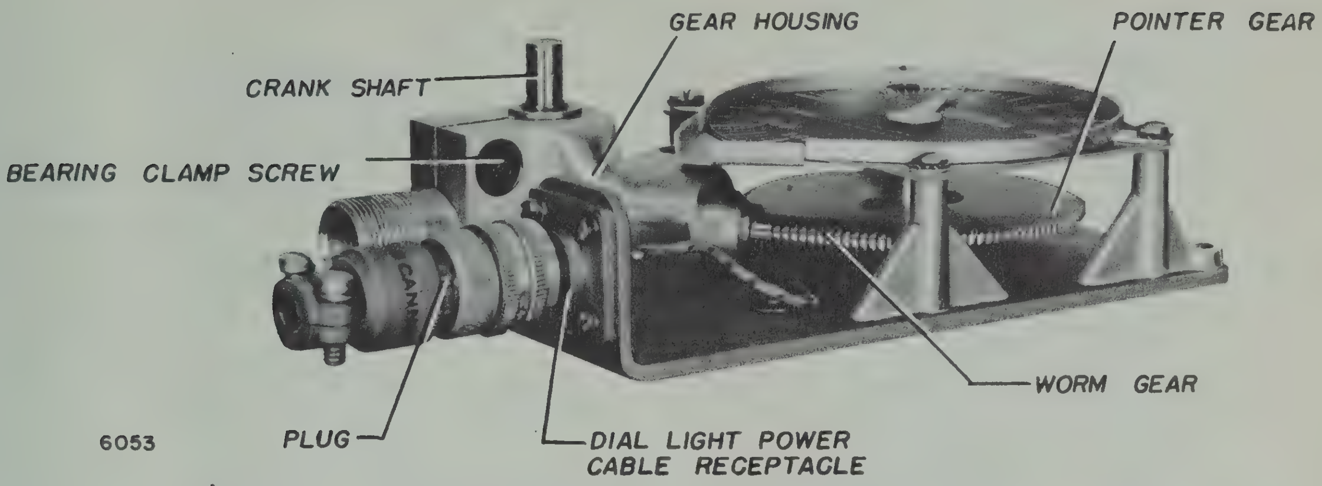


FIGURE 38 — TYPE MN-52G AZIMUTH CONTROL, OBLIQUE VIEW, COVER REMOVED

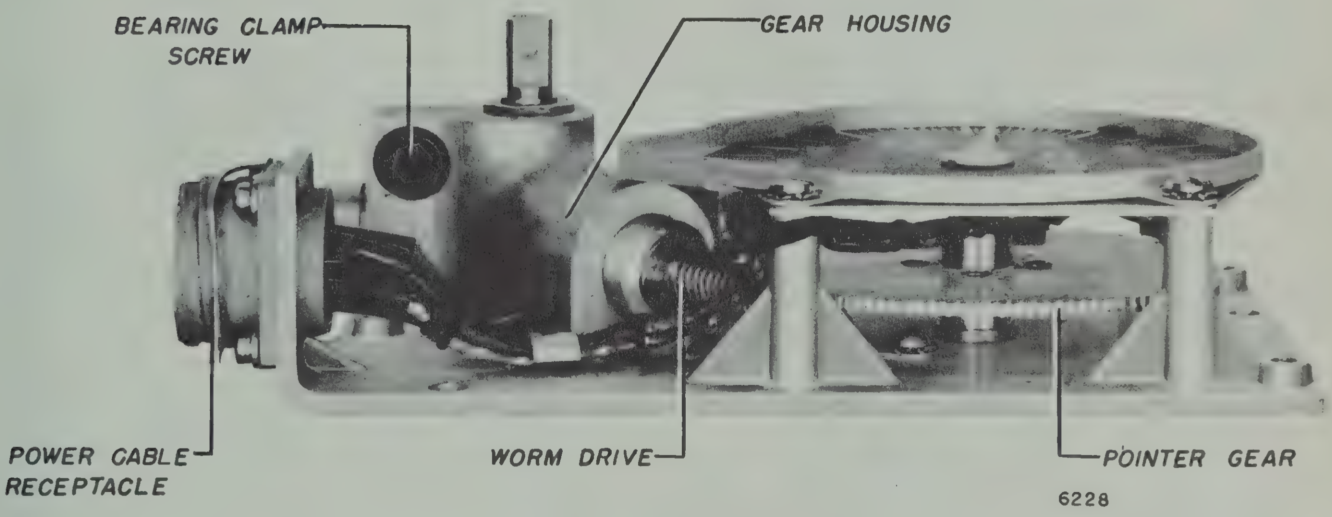


FIGURE 39 — TYPE MN-52J AZIMUTH CONTROL, RIGHT SIDE VIEW

radial lines spaced 15 degrees apart. The circles on the cam represent degrees of correction (column 6 of figure 80) and the distance between each circle is equivalent to 5 degrees. It will be noted that the maximum plus correction of 20 degrees is the outside diameter of the cam (for correction of minus 20° quadrantal error). A plus correction, advances the indicator pointer relative to the loop. With a sharp pointed scribe, lay out on the cam blank the contour indicated by the values listed in column 5 and column 6 of figure 80. A mark is made on the cam at the point where the (column 5 value) radial line intersects the (column 6) correction circle. A point should be marked at each radial line. Scratch a smooth connecting line through all the points. This line represents the contour of the cam. Sudden breaks in the contour usually indicate that a mistake has been made, and the cam layout at these points should be checked. Using first a coarse and then a fine file, carefully file away the cam to the countour line. The edge of the cam should be smooth and free from file marks.

(4) Reassemble the cam in the cam bracket with a lockwasher and nut. Do not fully tighten the nut. Assemble the cam bracket in the casting making certain that the cam follower pin is in contact with the edge of the cam. Keep the pointer at zero degrees on the dials and adjust the cam so that the zero-degree radial line is lined up with the mark on the cam follower pin. Tighten the nut.

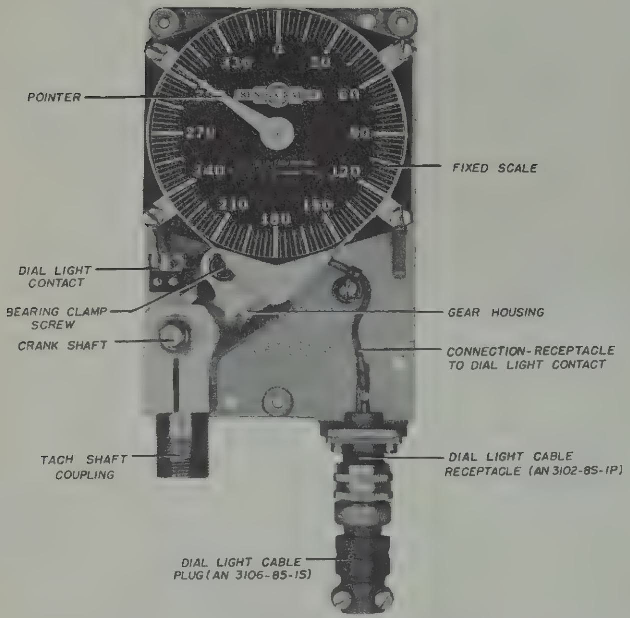


FIGURE 40 — TYPE MN-52G AZIMUTH CONTROL, FRONT VIEW, COVER REMOVED

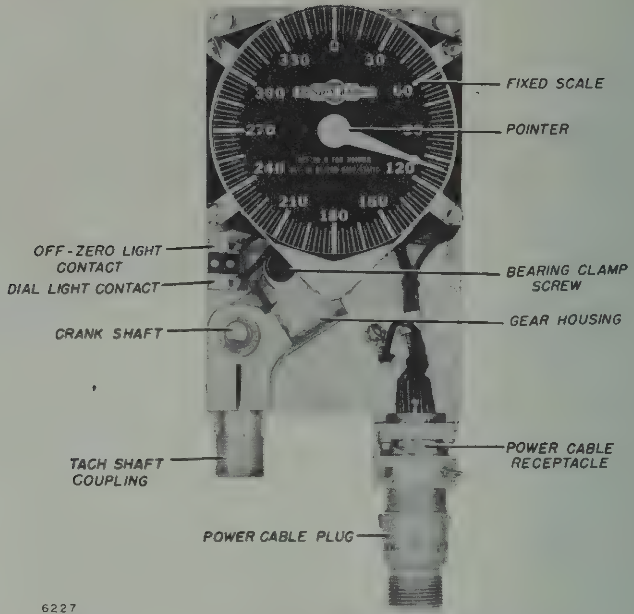


FIGURE 41 — TYPE MN-52J AZIMUTH CONTROL, FRONT VIEW, COVER REMOVED

(5) To check the cam assembly and contour, refer to the calibration curve. Set up the loop azimuth bearings as indicated on the cam by the cam follower pin, by revolving the coupling shaft. The pointer should read the corresponding true bearings. Settings hidden from view by the cam holder can be checked by counting the revolutions of the coupling shaft, as one complete turn of this shaft rotates the cam follower pin 3 degrees. Reassemble the back cover.

(6) If installation requirements have made it necessary to shift the zero position of the dials after the cam has been calibrated and filed, the cam will have to be set so that the cam follower pin is at zero on the cam when the pointer is at zero on the dials.

(7) Before recoupling the indicator to the loop shaft, set the pointer on zero and make certain that the loop has not shifted from its zero-degree heading.

c. If TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL is used it must be remembered that *it will be necessary at all times* when taking readings from the Azimuth Control dial to make use of the Quadrantal Calibration Curve, the making of which has been previously described. The reading taken from the Azimuth Control dial when the signal is at a minimum, is the *indicated radio bearing* of the transmitting station, relative to the heading of the plane. *The calibrated correction factor must then be applied to this reading in order to obtain the actual relative bearing.* In most cases the minimum signal will be less than a degree in width as observed on the meter. The ear may not be able to make so accurate an estimate; so that it becomes necessary to rotate the loop from one definite signal level, through the minimum, to an equal level on the other side. Observe the amount of rotation and the center of that area is the correct indicated bearing.

CAUTION: Any metallic masses, structures, or conductors in the field of the loop in which circulating RF currents may be induced, if later added, removed or altered, may destroy the accuracy of the calibrations. This applies to the bonding of the airplane, any change in fuselage structure, relocation of wiring or shielding, and spare parts or gear stowed near the loop. Check the calibrations in flight at frequent intervals by taking bearings on stations of known direction. The corrected indicated radio bearing added to the corrected magnetic heading should give the actual magnetic bearing to the transmitting station (subtract 360 degrees if necessary).

14. PERFORMANCE TESTS.

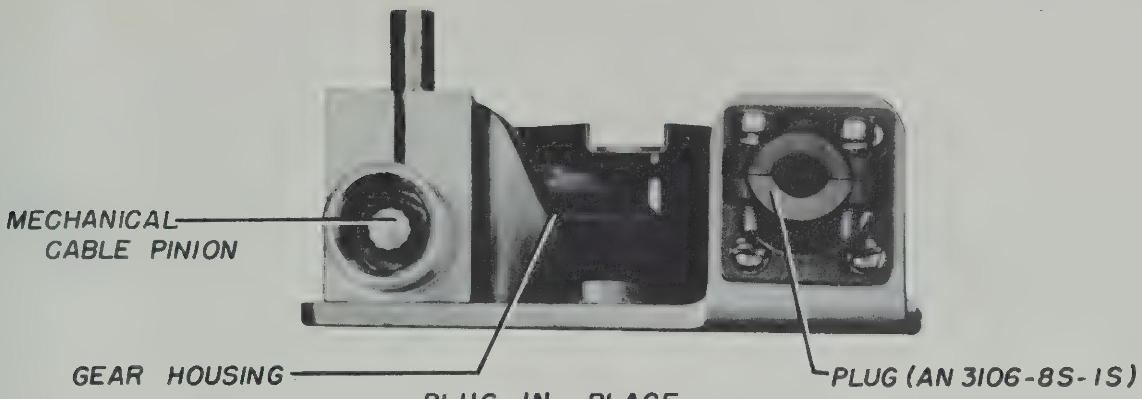
a. NORMAL RADIO RECEPTION.—To check normal radio reception:

(1) Set master switch on the remote control box to REC.ANT.

(2) Plug a telephone headset into TEL jack.

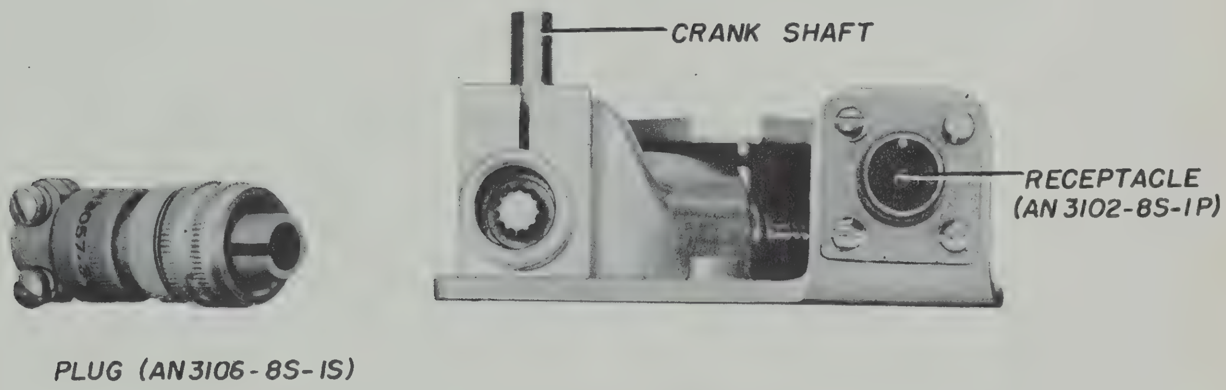
(3) Turn AUDIO control to maximum.

(4) Allow about forty seconds for the tube heaters to reach their operating temperature.



PLUG IN PLACE
(1)

6054



PLUG REMOVED
(2)

6055

Figure 42 — Type MN-52G Azimuth Control, Bottom View, Cover Removed

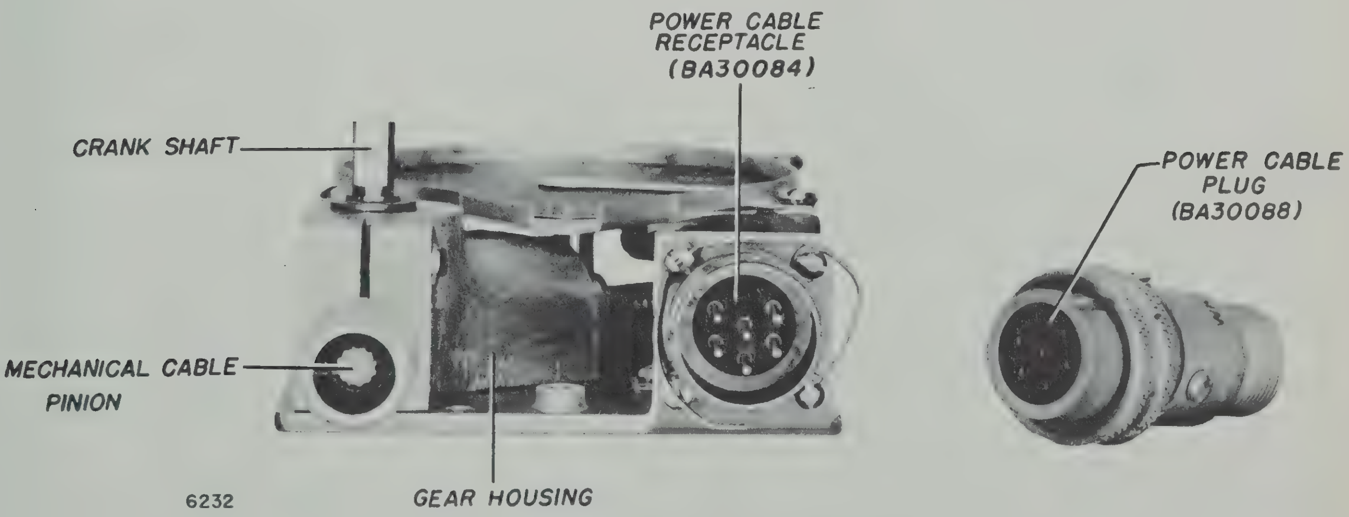


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Figure 43 — Type MN-52J Azimuth Control, Bottom View

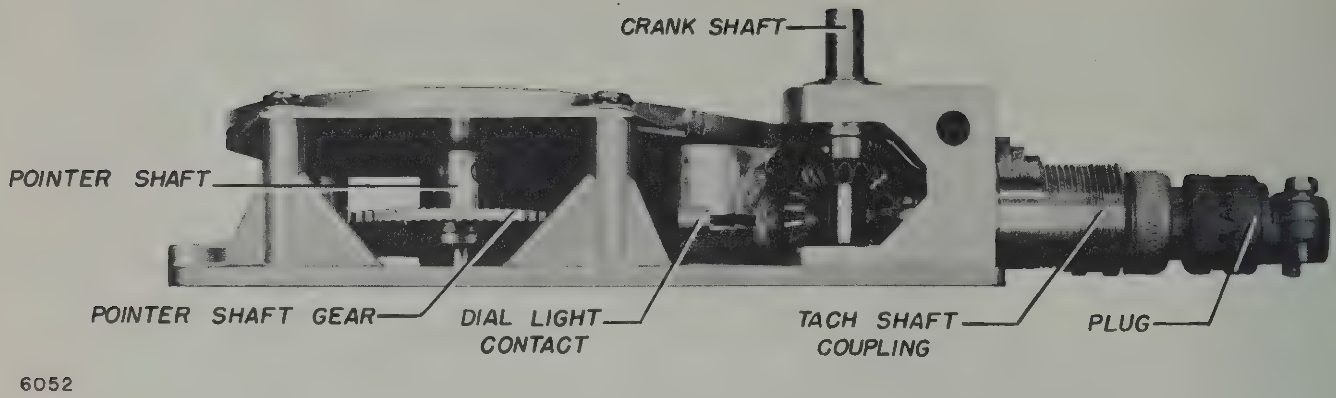


FIGURE 44 — TYPE MN-52G AZIMUTH CONTROL, LEFT SIDE VIEW, COVER REMOVED

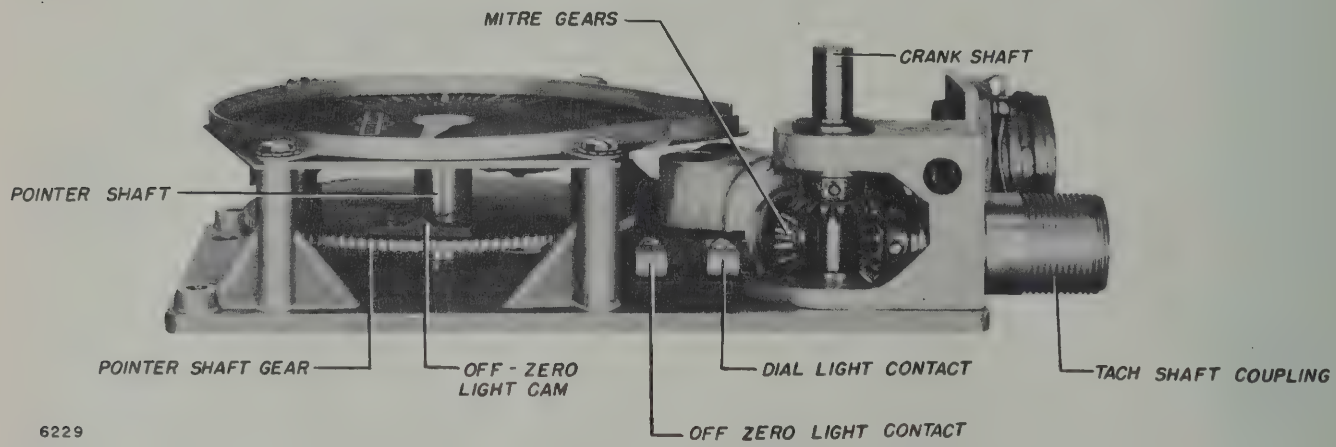


FIGURE 45 — TYPE MN-52J AZIMUTH CONTROL, LEFT SIDE VIEW

(5) Turn band selector switch to Band I.

(6) Operate the TUNING control until a signal is heard.

(7) Vary AUDIO control and note if smooth reduction of volume is obtained.

(8) Tune in several stations and note if the selectivity is good.

(9) Turn band selector switch to Bands II and III each time checking AUDIO control action and selectivity on several stations.

b. ANTI-STATIC RADIO RECEPTION.—To check anti-static reception:

(1) Set the function switch to REC. LOOP.

(2) Repeat instructions in section II paragraphs 14 *a* (2) to 14 *a* (6) inclusive.

(3) Operate crank drive until maximum signal is heard in the headset.

(4) Repeat instructions in section II, paragraphs 14 *a* (7), 14 *a* (8), and 14 *a* (9) and operate the crank drive each time for maximum signal in the headset.

c. DIRECTION FINDING.—To test direction finding performance:

(1) Set the function switch to COMP.

(2) Set aircraft in flying attitude headed toward true north.

(3) Tune in the signal from a weak station of known direction and rotate the crank drive until on-course indication is obtained on the left-right indicator, noting whether the azimuth indicator reading, as corrected for deviation, corresponds with the known direction of the transmitter.

(4) Turn aircraft to any other known direction and repeat instructions in section II, paragraph 14*c*(3).

15. OPERATION AND FUNCTIONING OF CONTROLS.

See figure 50 for controls described.

These controls are indicated on figure 50, by a figure and letter [such as (a1)] which refers to the part of this paragraph which describes the control.

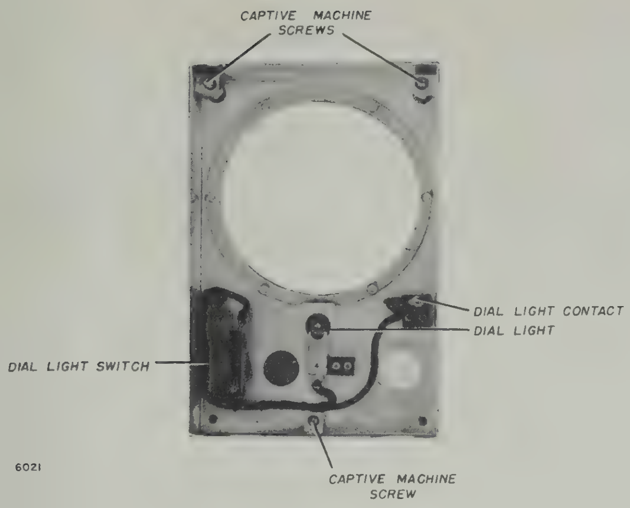


FIGURE 46 — TYPE MN-52G AZIMUTH CONTROL, VIEW INSIDE COVER

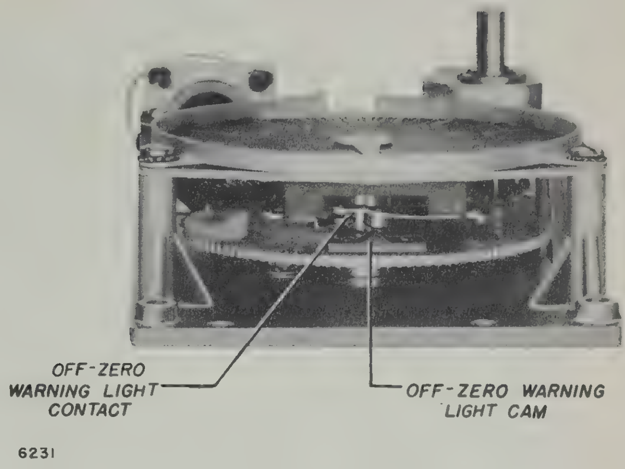


FIGURE 48 — TYPE MN-52J AZIMUTH CONTROL, TOP VIEW

a. TYPE MN-28 REMOTE CONTROL.—The functions of the controls on the remote control panel are as follows:

(1) OFF-COMP.—REC. ANT.—REC. LOOP.—A four position selector (a1) selects the desired operating function.

The COMP. setting is used for obtaining AURAL reception, visual on-course indication of homing and bearings. (Bands I and II only, on some models).

The REC. ANT. setting is used for communication and aural radio range reception.

The REC. LOOP setting is used for obtaining communications reception during conditions of severe rain and snow static, aural radio range reception, aural null bearings, and aural null homing from communication station. (Bands I and II only, on some models).

The OFF setting opens all current consuming circuits thus rendering the equipment inoperative.

(2) AUDIO.—The AUDIO control knob (a2) regulates the level of the audio signal in the headsets. This

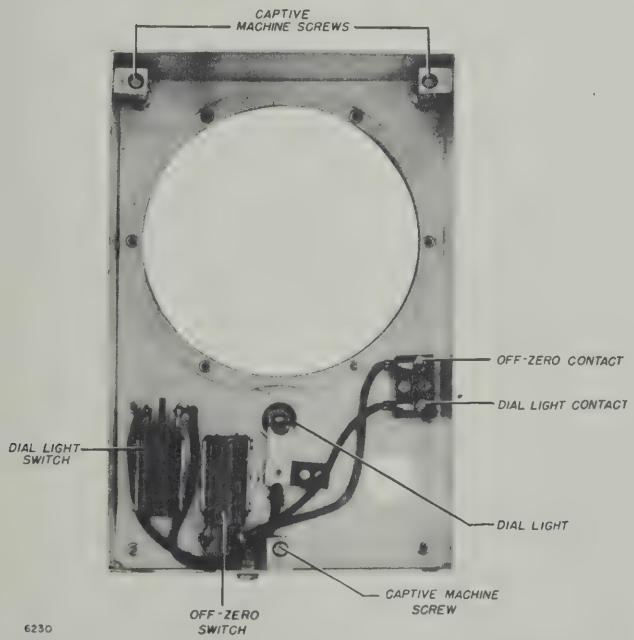


FIGURE 47 — TYPE MN-52J AZIMUTH CONTROL, VIEW INSIDE COVER

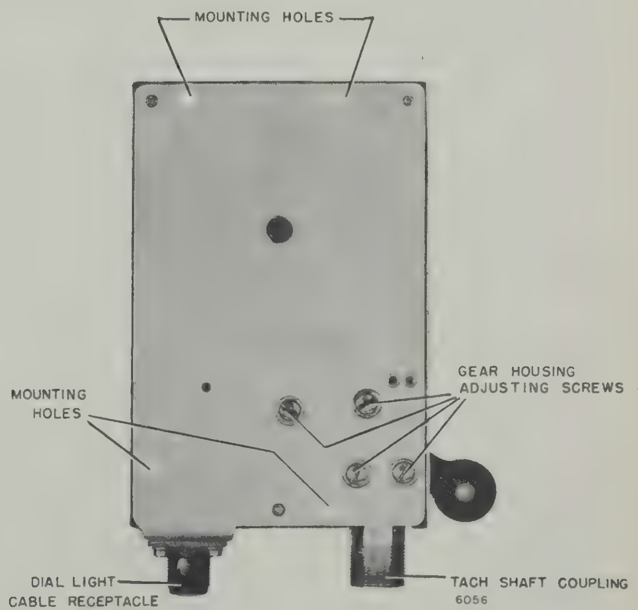


FIGURE 49 — TYPE MN-52G AZIMUTH CONTROL, BACK VIEW

control is a dual potentiometer (R4A and R4B) connected in the r–f amplifier cathode circuits and the headsets. When functioning as a compass, the equipment is operating on automatic volume control (AVC) and this knob (R4A section) determines the audio level in the headsets. When the equipment is functioning as a receiver, on either REC. ANT. or REC. LOOP this control varies the gain of the radio frequency amplifiers, permitting radio range reception.

(3) COMPASS.—The COMPASS control (a3) operates a potentiometer R3 to regulate the extent of pointer deflection (amount of swing of c3 toward c2 or c4) of the left-right indicator.

(4) C.W. ON-OFF.—The toggle switch S10 (a4) places the beat frequency oscillator in the circuit when in the ON position.

(5) FUSE.—The fuse FU1 (a5) protects the circuit elements of the equipment from an overload.

(6) TEL. JACKS.—The two jacks J1 and J2 (a6) receive standard two contact (barrel and tip) headset plugs.

(7) TUNING.—The TUNING crank (a7) operates the dial (all) and controls the variable capacitor thereby selecting the operating frequency.

(8) LIGHT.—The LIGHT control R6 (a8) adjusts the brilliancy of the dial light (a10).

(9) CHANNEL SELECTOR.—The three position switch S9 (a9) energizes band switch motor to select the desired frequency range and places a mask over the dial (all) which permits viewing only that part of the dial associated with the channel in use.

(10) DIAL LIGHT.—The Lamp LM-1 (a10) illuminates the dial (all) and is controlled by the LIGHT control (a8).

(11) DIAL.—The dial (all) indicates the frequency of the received signal.

b. TYPE MR-15A CRANK DRIVE. The function of the crank drive is as follows:

(1) CRANK.—The crank (b1) rotates the loop and the azimuth indicator pointer (d1) or (e1).

c. TYPE IN-4 LEFT RIGHT INDICATOR.—The function of the controls is as follows:

(1) ON-COURSE.—When the pointer (c3) is on the small figure of an airplane (c1) and the azimuth indicator pointer (d1) or (e1) is on 0, the aircraft is heading toward the transmitting station. When the pointer (c3) indicates on-course (c1) the plane of the loop is perpendicular to the transmitter (except for distortion) and the azimuth indicator pointer (d1) or (e1) indicates the direction, relative to the line-of-flight, of the incoming signal.

(2) RIGHT INDICATION.—When the pointer (c3) is on or near the right indicator (c2) the transmitter is to the right of the aircraft [with pointer (d1) or (e1) on 0] or to the right of the heading (or bearing) indicated by the pointer (d1) or (e1), (see figure 28).

(3) POINTER.—The pointer (c3) indicates the approximate direction of the incoming signals relative to the perpendicular plane of the loop (see figure 28).

(4) LEFT INDICATION.—The left indicator (c4) gives an indication opposite of that which the right indication (c2) gives ([see figure 28] and section II, paragraph 15*c*(2) above).

d. TYPE MN-40D AZIMUTH INDICATOR.—The function of the controls is as follows:

(1) POINTER.—The pointer (d1) indicates the direction of the transmitter antenna.

(2) VAR. KNOB.—The VAR. knob (d2) rotates the scale (d4).

(3) INDEX MARK.—The index mark (d3) indicates the heading of the aircraft. The VAR. knob (d2) is rotated until the true bearing (relative to true north) is indicated on the scale (d4) opposite the index mark (d3).

(4) SCALE.—The scale (d4) indicates the bearing of the transmitter antenna when the azimuth indicator has been corrected for quadrantal error (section II, paragraph 13*a*). If the index mark (d3) is opposite zero on the scale (d4) the pointer (d1) indicate the aircraft-to-transmitter bearing. If the index mark (d3) is opposite the true bearing of the aircraft-heading on the scale (d4) the pointer (d1) will indicate the bearing (relative to true north) of the transmitter antenna.

(5) TAIL END.—The tail end (d5) of the pointer (d1) indicates the reciprocal bearing of the transmitter antenna. The bearing, on the scale (d4) at this point, is used in plotting the position and course of the aircraft.

e. TYPE MN-22A AZIMUTH INDICATOR.—The function of the controls is as follows:

(1) POINTER.—The pointer (e1) indicates the direction of the transmitter antenna.

(2) KNOB.—The knob (e2) rotates the inner scale (e5).

(3) OUTER (FIXED) SCALE.—The outer scale (e3) indicates the bearing between the transmitter antenna and aircrafts line of flight at the arrow end of the pointer (e1).

(4) EAST-WEST-VARIATION SCALE.—The variation scale (e4) indicates the variation of the magnetic north to the true north. The use of this scale is described in section II, paragraph 15*e*(5) below.

(5) INNER (MOVABLE) SCALE.—The inner scale (e5) indicates the bearing (relative to north) of the transmitter antenna after the dial (e5) has been set to bearing of the aircraft. The inner dial (e5) is rotated by means of the knob (e2) until the magnetic bearing of the aircraft is indicated on the inner scale (e5) opposite the zero (0) on the outer scale (e3) or east-west

variation scale (e4). The scale (e5) is corrected for magnetic deviation by first noting the number on the inner scale (e5) opposite the variation scale (e4), then rotating knob (e2) until this number is opposite the known east or west magnetic deviation for the locality on the variation scale (e4).

(6) TAIL END.—The tail end (e6) of the pointer (e1) indicates the reciprocal bearing of the transmitter antenna. After the inner scale (e5) has been set for the bearing of the aircraft, the bearing indicated on the inner scale (e5) under the tail end (e6) of the pointer (e1) is used in plotting the position and course of the aircraft.

f. TYPE MN-52G AZIMUTH CONTROL.—The functions of the controls are as follows; (See fig. 51).

(1) CRANK—Crank (1) operates the loop mechanism by means of connection made through a mechanical cable. Crank also operates dial pointer.

(2) POINTER.—The pointer (2) indicates the approximate direction of the incoming signals relative to the plane of the loop.

(3) SWITCH.—The switch (3) controls the dial light current, turning it on when the knob is thrown to the LIGHT position.

(4) FIXED SCALE.—The scale (4) indicates the bearing, (read at end of pointer) between the transmitter antenna and the aircraft's line of flight.

(5) DIAL LIGHT.—The dial light (5) illuminates the fixed scale.

(6) MECHANICAL CABLE CONNECTION.—(6) receives mechanical cable AA15410 connecting Azimuth Control to loop.

(7) DIAL LIGHT POWER CABLE RECEPTACLE.—(7) receives plug on end of power cable furnishing current to dial light.

g. TYPE MN-52J AZIMUTH CONTROL.—The function of the controls are as follows; (See fig. 52)

(1) CRANK.—Crank (1) operates the loop mechanism by means of connection made through a mechanical cable. Crank also operates dial pointer.

(2) POINTER.—The pointer (2) indicates the approximate direction of the incoming signals relative to the plane of the loop.

(3) DIAL LIGHT SWITCH.—The switch (3) controls the dial light current, turning it on when the knob is thrown to the LIGHT position.

(4) OFF-ZERO SWITCH.—The switch (4) controls the off-zero warning light circuit. The circuit is closed and the warning light will function when the switch is in the LOOP position.

(5) FIXED SCALE.—The scale (5) indicates the bearing, (read at end of pointer) between the transmitter antenna and the aircraft's line of flight.

(6) DIAL LIGHT.—The dial light (6) illuminates the fixed scale.

(7) MECHANICAL CABLE CONNECTION.—(7) receives mechanical cable AA15410 connecting Azimuth Control to loop.

(8) POWER CABLE RECEPTACLE.—(8) receives plug on end of power cable furnishing current to dial light and the off-zero warning light circuit. The receptacle also receives connections linking that part of the off-zero warning light circuit within the control box with the warning light which is located elsewhere.

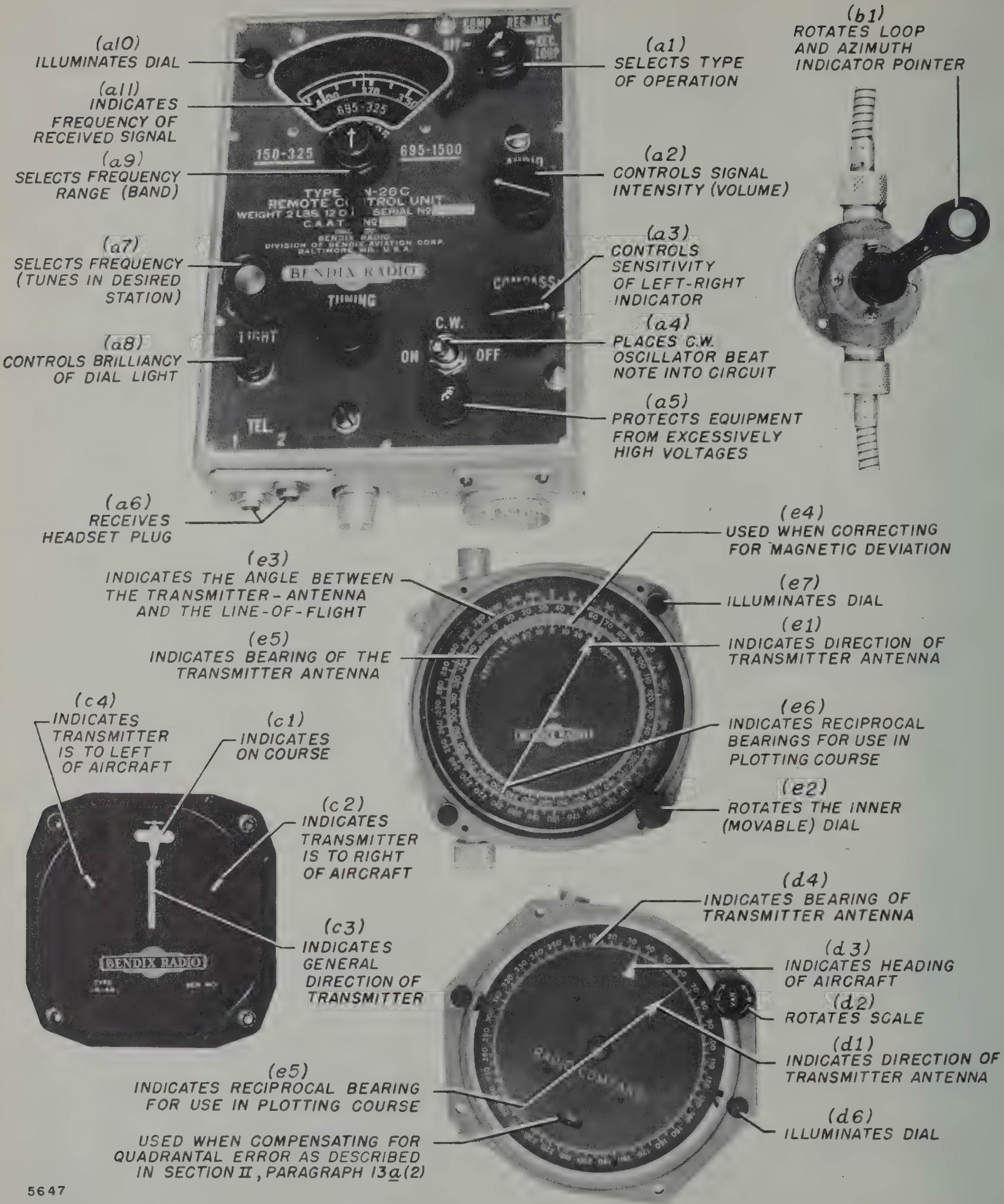


FIGURE 50 — FUNCTION OF CONTROLS

SECTION III
OPERATION

16. COMMUNICATIONS RECEPTION (See figure 50).

a. GENERAL.—The MN-26 radio compass equipment may be used for normal reception of communications using a fixed antenna or, in times of extreme rain or snow static conditions, the loop antenna may be used in place of the vertical antenna for anti-static reception. Anti-static reception is not used at all times because of the lower over-all sensitivity when using the loop only.

b. NORMAL RECEPTION (ANTENNA)

(1) Turn function switch (a1) to REC. ANT.

(2) Select desired frequency range (a9).

(3) Snap C.W. switch (a4) ON or OFF as desired.

(4) Tune in station (a7).

(5) Adjust AUDIO control (a2) for desired headset volume.

The COMPASS control (a3) is not used for reception of communications.

c. ANTI-RAIN-STATIC RECEPTION (LOOP).—The operation procedure is as follows: (Bands I and II only in some models):

(1) Turn function switch (a1) to REC. LOOP.

(2) Select desired frequency range (a9).

(3) Snap C.W. switch (a4) ON or OFF as desired.

(4) Tune in station (a7).

(5) Rotate crank drive (b1) for maximum output in headset.

NOTE: The crank drive mentioned above refers to crank (7) figure 51, if Type MN-52G or Type MN-52J AZIMUTH CONTROL is used.

(6) If the station is to the left or right of the airplane's course, it will occasionally be necessary to readjust the azimuth control setting (b1) for maximum signal.

(7) Adjust AUDIO control (a2) for desired headset volume.

17. HOMING (See figure 50).

a. RADIO RANGE RECEPTION.—It is necessary either to have a map showing the radio range course and characteristics, or to know the location of the course and its characteristic A and N signal areas. The operating procedure is as follows:

(1) Turn function switch (a1) to REC. ANT.

(2) Turn band switch (a9) to Band I (150–325 or 200–410).

(3) Tune (a7) to desired frequency.

(4) Adjust AUDIO control (a2) to desired signal level.

(5) Obtain a fix position, see section III, paragraph 18*d*, thus determining the direction to the course it is desired to follow.

(6) Turn plane so as to intercept the radio range course.

(7) The A and N signals will blend into a continuous dash interrupted by the station identification when on course.

(8) The plane may then be flown on course to the location of the radio range station.

(9) Arrival at destination is indicated by an abrupt decrease in headset volume known as the cone of silence.

(10) A radio range course may also be flown with anti-rain-static reception in which case the function switch (a1) would be set on REC.LOOP and the crank drive (b1) rotated for maximum signal strength at approximately 90-degree (d4 or e3) or 270-degree (b1) (d4 or e3) settings.

NOTE: The crank drive mentioned above refers to crank (7) figure 51, if TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL is used.

b. VISUAL RADIO COMPASS HOMING.—The operating procedure is as follows:

(1) Set azimuth indicator (d4 or e3) at zero.

NOTE: If TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL is used this reference still applies.

(2) Adjust COMPASS control (a3) to maximum.

(3) Turn function switch (a1) to COMP.

(4) Select desired frequency range (a9) and tune in station (a7).

(5) Listen carefully for station identification to be sure that the desired station is being received. AUDIO control (a2) may be set for any audio output level without affecting the deflection of the left-right indicator needle.

(6) Alter the airplane's course to left or right as shown by the left-right indicator needle (c3) until reading is zero or on course (c1).

(7) Although on-course indications (c1) will be obtained both when approaching and when flying away from a transmitter (see figure 55) no confusion as to location of the station need result. If a course correction, to the right for example, is accompanied by a de-

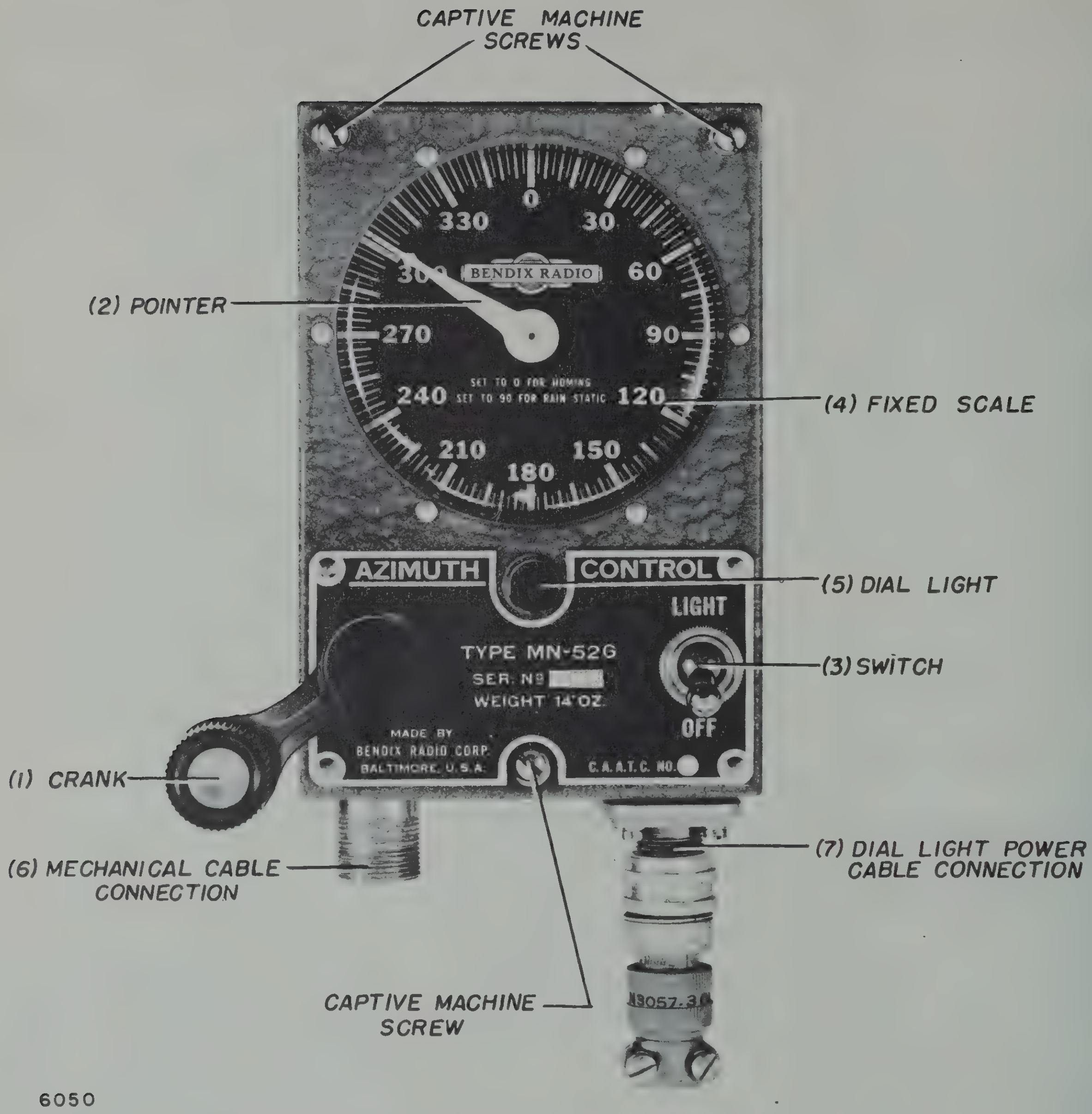


FIGURE 51 — TYPE MN-52G AZIMUTH CONTROL, FUNCTION OF CONTROLS

flection of the indicating needle in the same direction (c2) the station is aft, while if the deflection is in the opposite direction (c4) the station is ahead. The indicator needle (c3) points in the general direction of the transmitting station.

(8) Reduce COMPASS control (a3) setting until an intermediate value has been found which permits following the course accurately without continuous hunting.

c. AURAL NULL HOMING.—Aural null homing may be used in place of visual radio compass homing should any of the compass circuits or indicator be inoperative or in case of severe rain static. This method is not as desirable as radio compass homing because of the possibility of 180 degrees ambiguity of direction. The operation procedure is as follows:

(1) Turn function switch (a1) to REC. LOOP.

(2) Select desired frequency range (a9) and tune in station (a7).

(3) Listen carefully for station identification.

(4) When homing on weak signals, turn C.W. switch (a4) ON.

(5) Adjust AUDIO control (a2) for the desired audio level.

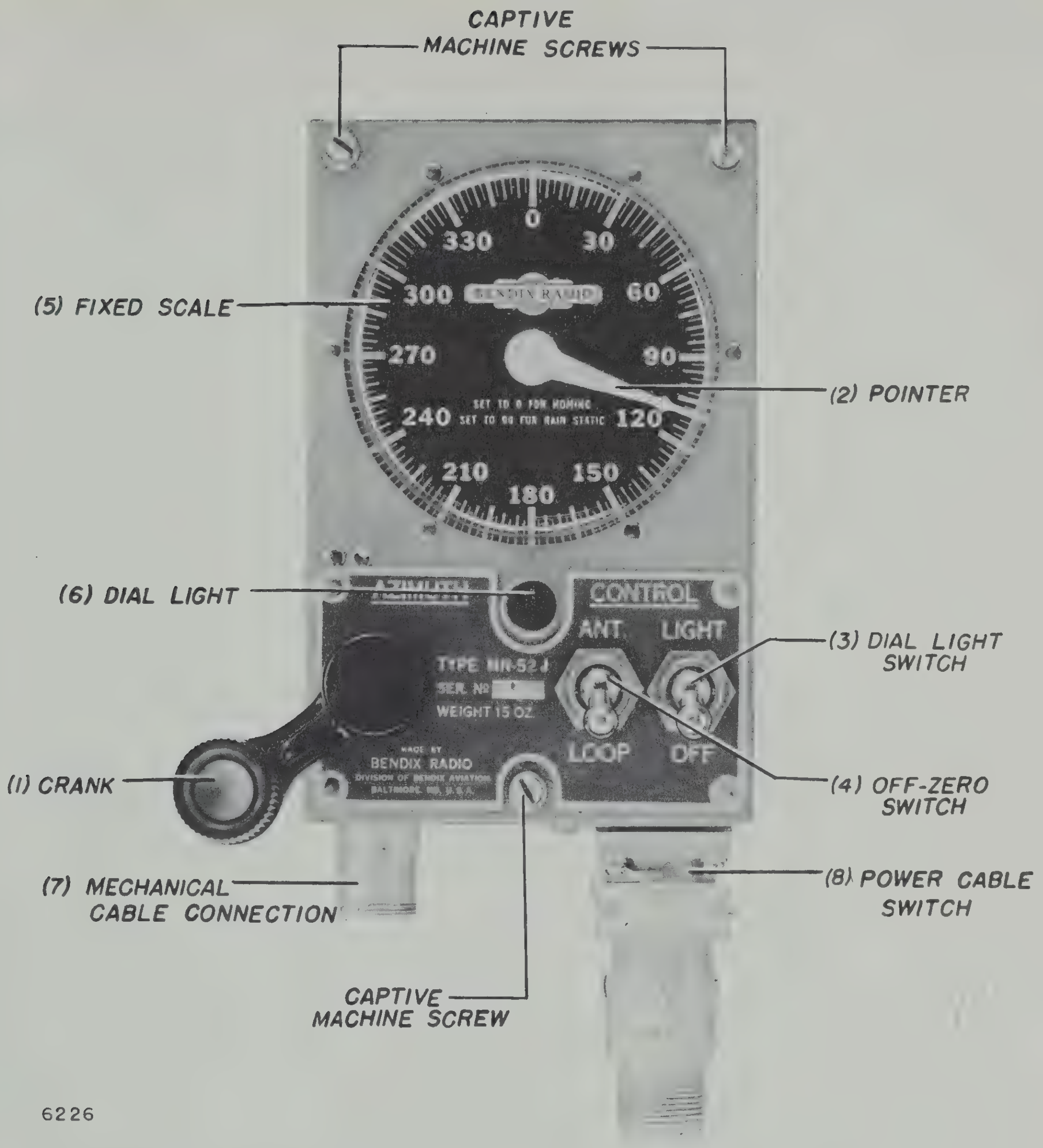


FIGURE 52 — TYPE MN-52J AZIMUTH CONTROL, FUNCTION OF CONTROLS

(6) Rotate crank drive (b1) for zero reading on the azimuth indicator (d4 or e3).

(7) Turn airplane until headphone volume decreases the minimum.

(8) Fly plane on this null course until desired position has been reached.

18. DIRECTION FINDING (See figure 50).

a. VISUAL BEARINGS.—The operating procedure for obtaining radio compass bearings when using Type MN-40D Azimuth Indicator is as follows:

(1) Turn function switch (a1) to COMP.

(2) Adjust COMPASS control (a3) for desired sensitivity of the left-right indicator.

(3) Select frequency range (a9) and tune in desired station (a7). Check station identification to be sure of having correct station.

(4) Using the VAR. knob (d2), set the bearing scale (d4) so that the numerical value of the aircraft's magnetic heading is at the index mark (d3).

(5) Determine the magnetic variation for the locality. Rotate the VAR. knob (d2) for the required correction in the direction indicated by the arrows on the VAR. knob (d2). The knob (d2) is marked with

arrows to show the proper direction of rotation to compensate for East or West variation. (This is not necessary when obtaining a "fix".)

(6) Rotate the crank drive (b1) until the compass indicator needle (c3) is at the center position (c1). If the needle (c3) points to the right (c2), the crank drive (b1) is rotated for an increasing azimuth indicator reading (d4), and if the needle (c3) points to the left (c4), the crank drive is rotated for a decreasing reading (d4). Another method is to watch the left-right indicator needle (c3) while rotating the crank (b1). Turn the crank for clockwise rotation of the azimuth indicator pointer (d1); if the compass needle (c3) moves left, the correct bearing is being taken. If the compass needle moves right, rotate the azimuth-indicator pointer 180 degrees.

(7) When the compass needle (c3) indicates on-course (c1), record the reading of the scale (d4) under the tail end (d5) of the pointer (d1). The arrow end of the pointer (d1) indicates the magnetic bearing from the aircraft to the transmitting antenna while the tail end (d5) of the pointer (d1) indicates the magnetic bearing from the transmitting antenna to the aircraft and this bearing is used for plotting the location and course of the aircraft as explained in section III, paragraph 18*e*.

b. AURAL-NULL METHOD WITH TYPE MN-40D AZIMUTH INDICATOR.—The operating procedure for obtaining radio compass bearing by the aural null method when using Type MN-40D Azimuth Indicator is as follows:

(1) Turn function switch (a1) to REC.LOOP.

(2) Select frequency range (a9) and tune in desired station (a7). When listening for station identification it may be necessary to rotate the loop (b1) to a maximum signal position to obtain a good intelligible signal.

(3) Adjust AUDIO control (a2) for desired headset level.

(4) Rotate the VAR. knob (d2) until the magnetic heading of the aircraft is at the index mark (d3) on the scale (d4).

(5) Determine the magnetic variation for the locality, and rotate the VAR. knob (d2) for the required correction. (This is not necessary when obtaining a "fix").

(6) Rotate the crank drive (b1) until a sharp decrease is noticed in the headset volume. If the signal exists over too wide an angle, greater accuracy may be obtained by setting the AUDIO control (a2) on maximum, and locating null by either listening for the disappearance of the audio signal, or noting the dip (left deflection) in the tuning meter deflection.

(7) Record the reading of the scale (d4) at the tail end (d5) of the pointer (d1). Bearings are subject to 180-degree ambiguity but this will not matter when plotting the position of the aircraft if bearings are taken on two or more stations.

c. VISUAL BEARINGS WITH TYPE MN-22A AZIMUTH INDICATOR (see figures 50, 53, and 54).—The operating procedure for obtaining radio compass bearings when using Type MN-22A Azimuth Indicator is as follows:

(1) Turn function switch (a1) to COMP.

(2) Adjust COMPASS control (a3) for desired sensitivity of the left-right indicator.

(3) Select frequency range (a9) and tune in desired station (a7). Check station identification to be sure of having correct station.

(4) Rotate the knob (e2) until the numerical value of the aircraft magnetic heading is indicated on the inner scale (e5) opposite the zero (0) on the outer scale (e3). (Illustrated as angle "B" in figure 53).

(5) Determine the magnetic variation for the locality in which the aircraft is located. Note the number on the inner scale (e5) opposite the zero (0) on the east-west variation scale (e4), and rotate the knob (e2) until this number on the inner scale (e5) is opposite the number of degrees variation (east or west) on the variation scale (e4). (This is not necessary when obtaining a "fix").

(6) Rotate the crank drive (b1) until the compass needle (c3) indicates on-course (c1).

(7) The pointer (e1) now indicates the following:

(*a*) The relative bearing between the aircraft's line-of-flight and the transmitting antenna on the outer scale (e3) at the arrow end of the pointer (e1). (Angle "A" of figure 53).

(*b*) The bearing of the transmitting antenna relative to magnetic north on the inner scale (e3) at the arrow end of the pointer (e1). (Angle "E" of figure 53).

(*c*) The reciprocal bearing of the transmitting antenna on the inner scale (e5) at the tail end (e6) of the pointer (e1) scale (e5) at the tail end (e6) of the pointer (e1). This is used for locating the aircraft and plotting the course.

d. AURAL-NULL METHOD WITH TYPE MN-22A AZIMUTH INDICATOR (see figures 50, 53, and 54).—The operating procedure for obtaining radio compass bearings by the aural-null method when using Type MN-22A Azimuth Indicator is as follows:

(1) Turn function switch (a1) to REC. LOOP.

(2) Select frequency range (a9) and tune in desired station (a7). When listening for station identification it may be necessary to rotate the crank drive (b1) for maximum signal strength.

(3) Adjust AUDIO control (a2) for desired volume.

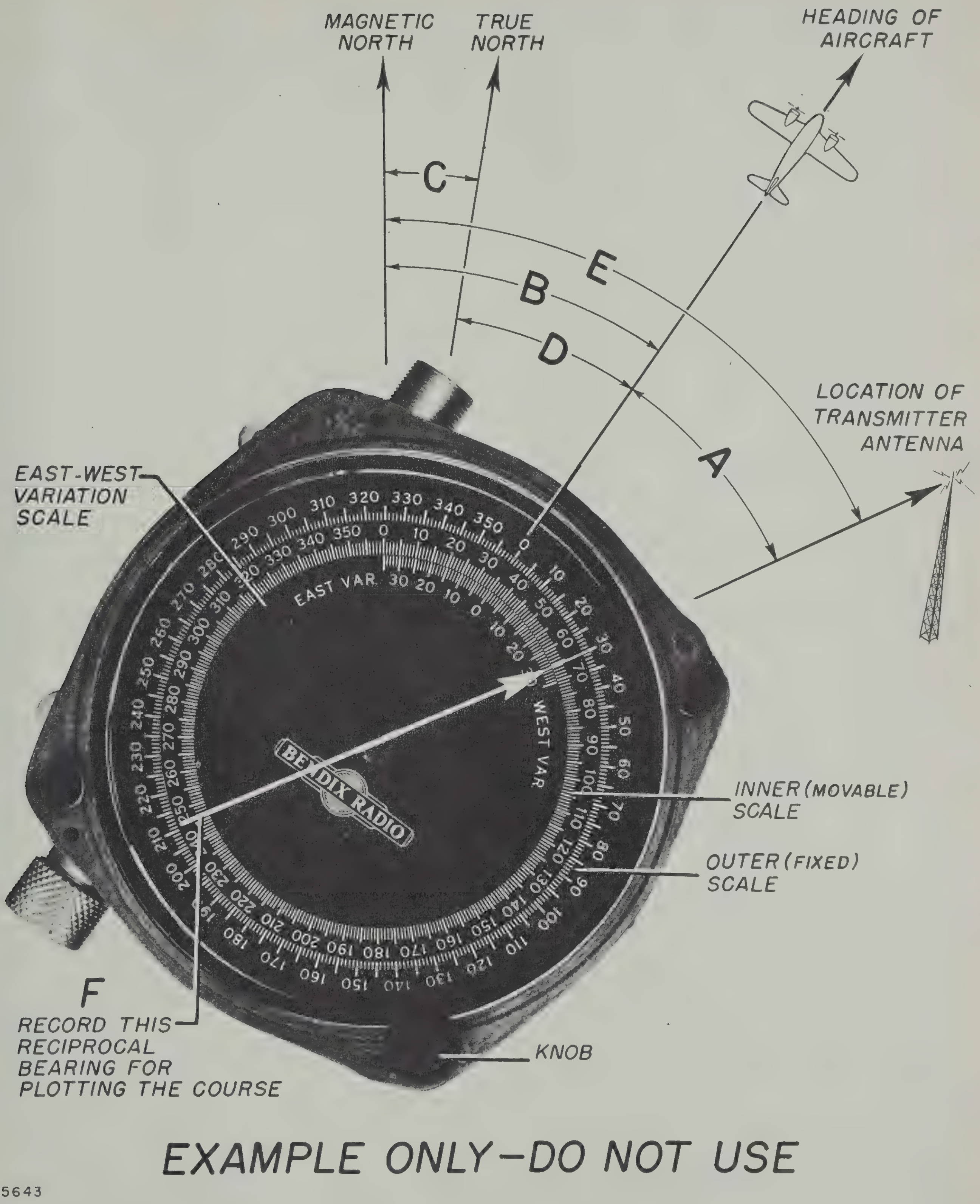


FIGURE 53 — TYPE MN-22A AZIMUTH INDICATOR, FUNCTION OF SCALES

(4) Rotate the knob (e2) until the magnetic heading of the aircraft is indicated on the inner scale (e5) at the zero (0) on the outer scale (e3). (Paragraph 18*d* (5) is not necessary when obtaining a "fix"). (This is angle "B" of figure 34).

(5) Determine the magnetic variations for the locality. Rotate the knob (e2) until the number on the inner scale (e5) [at the zero (0) on the variation scale (e4)] is located opposite the number of degrees variation on the variation scale (e4). (This variation is shown by angle "C" in figure 53).

(6) Rotate the crank drive (b1) until the compass needle (c3) indicates on-course (e1).

(7) Record the reading of the inner scale (e5) at the tail end (e6) of the pointer (e1). (This is "F" in figure 53). This value is used in plotting the course of the aircraft as described in section III paragraph 18*e*. This bearing is subject to 180-degrees ambiguity.

e. VISUAL BEARING WITH TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL.—The operating procedure for obtaining radio compass bearings when using Type MN-52G Azimuth Control is as follows:

(1) Turn master switch to COMP.

(2) Adjust COMPASS control for desired sensitivity.

(3) Select frequency range and tune in desired station. Check identification to be sure of having correct station.

(4) Observe left-right indicator needle; if needle points toward the right rotate loop for an increasing azimuth control dial reading, or if it points toward the left, rotate loop for a decreasing azimuth control dial reading, continuing rotation until an on-course indication is obtained.

(5) Observe reading of the azimuth control dial which is relative to the airplane's line of flight.

(6) Observe actual magnetic heading from the corrected ship's compass reading.

(7) Correct azimuth control reading for deviation and, if a Type MN-52G Azimuth Control is used, add corrected reading to actual magnetic heading. Subtract 360 if the sum permits. The final figure will give the true magnetic bearing of the transmitting station with respect to the position of the airplane. To correct this bearing to the magnetic bearing of the airplane with respect to the station, for plotting on a chart, add 180 degrees.

f. AURAL-NULL METHOD WITH TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL.—The operating procedure for obtaining radio compass bearing by the aural-null method when using Type MN-52G or Type MN-52J Azimuth Control is as follows:

(1) Turn master switch to REC. LOOP.

(2) Select desired frequency range and tune in station. Check station identification.

(3) When taking bearings of weak signals, it is helpful to use the CW Oscillator beat note.

(4) Adjust AUDIO control for desired audio level.

(5) Rotate azimuth control until headset volume decreases to minimum.

(6) Observe reading of azimuth control dial which is relative to the airplane line of flight.

(7) Observe actual magnetic heading from the corrected ship's compass reading.

(8) Correct azimuth reading for deviation and add corrected reading to the actual magnetic heading. Subtract 360 if the sum permits. The final figure will give either the true magnetic bearing of the transmitting station or its reciprocal, with respect to the position of the airplane.

g. DIRECTION FINDING PRECAUTIONS.

When for any reason, broadcast station carriers are being used for obtaining bearings, care must be exercised in the selection of stations. Two stations operating on the same frequency may tend to indicate more than one direction, or may fail to give any indication of direction whatever. Stations operating on clear channels will always give the most satisfactory results. Note that broadcast transmitting stations are often situated a considerable distance outside of cities controlling them.

Night effect, or reflection of the radio wave from the sky, is always present. It may be recognized by a fluctuation in bearings.

Try the following to eliminate night effect:

(1) Increase altitude thereby increasing the strength of the direct wave.

(2) Take an average of the fluctuations.

(3) Select a lower frequency station.

Night effect is worse at sunrise and sunset. Night effect is present on stations at 1500 Kcs at distances greater than 20 miles, and as the frequency decreases the distance increases until at 200 Kcs the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances.

h. VISUAL RADIO COMPASS HOMING.

The operating procedure is as follows:

(1) Set azimuth control at zero.

(2) Adjust COMPASS control to maximum.

(3) Turn master switch to COMP.

(4) Select desired frequency range and tune in station.

(5) Listen carefully for station identification to be sure that the desired station is being received. AUDIO control may be set for any audio output level without

affecting the deflection of the left-right indicator needle.

(6) Alter the airplane's course to left or right as shown by the left-right indicator needle until reading is zero or on-course.

(7) Although on-course indications will be obtained both when approaching and when flying away from a transmitter no confusion as to location of the station need result. If a course correction, to the right for example, is accompanied by a deflection of the indicating needle in the same direction, the station is aft, while if the deflection is in the opposite direction, the station is ahead. The indicator needle points in the general direction of the transmitting station.

(8) Reduce COMPASS control setting until an intermediate value has been found which permits following the course accurately without continuous hunting.

i. AURAL NULL HOMING.

Aural null homing may be used in place of visual radio homing should any of the compass circuits or indicator be inoperative or in case of severe rain static. This method is not so desirable as radio compass homing because of the possibility of 180 degrees ambiguity of direction.

The operating procedure is as follows:

(1) Turn master switch to REC. LOOP.

(2) Select desired frequency range and tune in station.

(3) Listen carefully for station identification.

(4) When homing on weak signals, turn C.W. switch ON.

(5) Adjust AUDIO control for the desired audio level.

(6) Rotate azimuth control off zero. *The warning light, if used, must be off.*

(7) Turn airplane until headphone volume decreases to minimum.

(8) Fly plane on this null course until desired position has been reached.

j. PLOTTING LOCATION AND COURSE OF AIRCRAFT (see figures 53 and 54).—The location of the aircraft at a given time may be determined by plotting the radio bearings obtained from two or more known radio stations. The intersection of the plotted bearings is the location of the aircraft at the time the bearings were obtained, provided, of course, that the bearings are not in error, and that the elapsed time from one radio bearing to the next is small enough so that the distance travelled by the aircraft may be neglected. A third radio bearing is usually obtained as a check on the first two. The three bearings should intersect at one point but generally form a small triangle at their intersection. A comparatively large triangle obtained by plotting three bearings indicates that at least one of the bearings may be in error or that too much time has elapsed between successive bearings. In cases where appreciable movement of the aircraft has occurred between radio bearings, the approximate locations of the aircraft at the time each bearing was taken may be obtained by a simple graphical solution. A line is shifted on the map or chart, parallel to the heading of the aircraft, until the distances between the plotted bearings on this line correspond in order to the scale distances covered by the aircraft between consecutive bearings. This assumes that all bearings are equally accurate and that a uniform speed and direction of flight has been maintained during the time the bearings have been taken.

Either true bearings or magnetic bearings may be used for a position fix. In the example given below, the use of magnetic bearings and headings will be assumed since practically all aerial navigation is based on the magnetic compass. The use of charts similar to the Radio Direction Finder Charts for Aeronautical Use prepared by the U. S. Coast and Geodetic Survey is also assumed. These Direction Finder charts have magnetic compass roses centered on the radio stations so that magnetic bearings may be easily plotted with a straight edge.

Two or preferably three known radio stations providing useable signals are chosen prior to the time the fix is to be obtained. Their frequencies or dial positions are noted in increasing or decreasing order so that tuning from one station to the next may be accomplished in a minimum of time. The directional gyro is caged to a corrected magnetic compass reading and the aircraft held as close as possible to this magnetic course. The heading must be held constant while the bearings are being taken. The azimuth scale of the radio bearing indicator is then rotated until the zero index indicates the magnetic heading of the aircraft so that bearings referred to Magnetic North may be read directly from the azimuth scale. The radio station having the highest (or lowest) frequency or dial is tuned in on the radio compass, the crank rotated until the left-right indicator needle is at center, and the reading of the bearing indicator is noted for this radio station. The radio compass is immediately tuned to the second radio station, so that the radio bearing for that station may be obtained. The third radio station is tuned in and a third reading of the bearing indicator noted.

The three radio bearings obtained are magnetic bearings from the aircraft to the respective radio stations. Since the position of the aircraft is unknown. the bearings must be plotted from the radio stations. The approximate location of the aircraft is spotted on the D/F chart either by dead reckoning or by plotting the reciprocal radio bearings from the known radio stations. An accurate location is then determined by

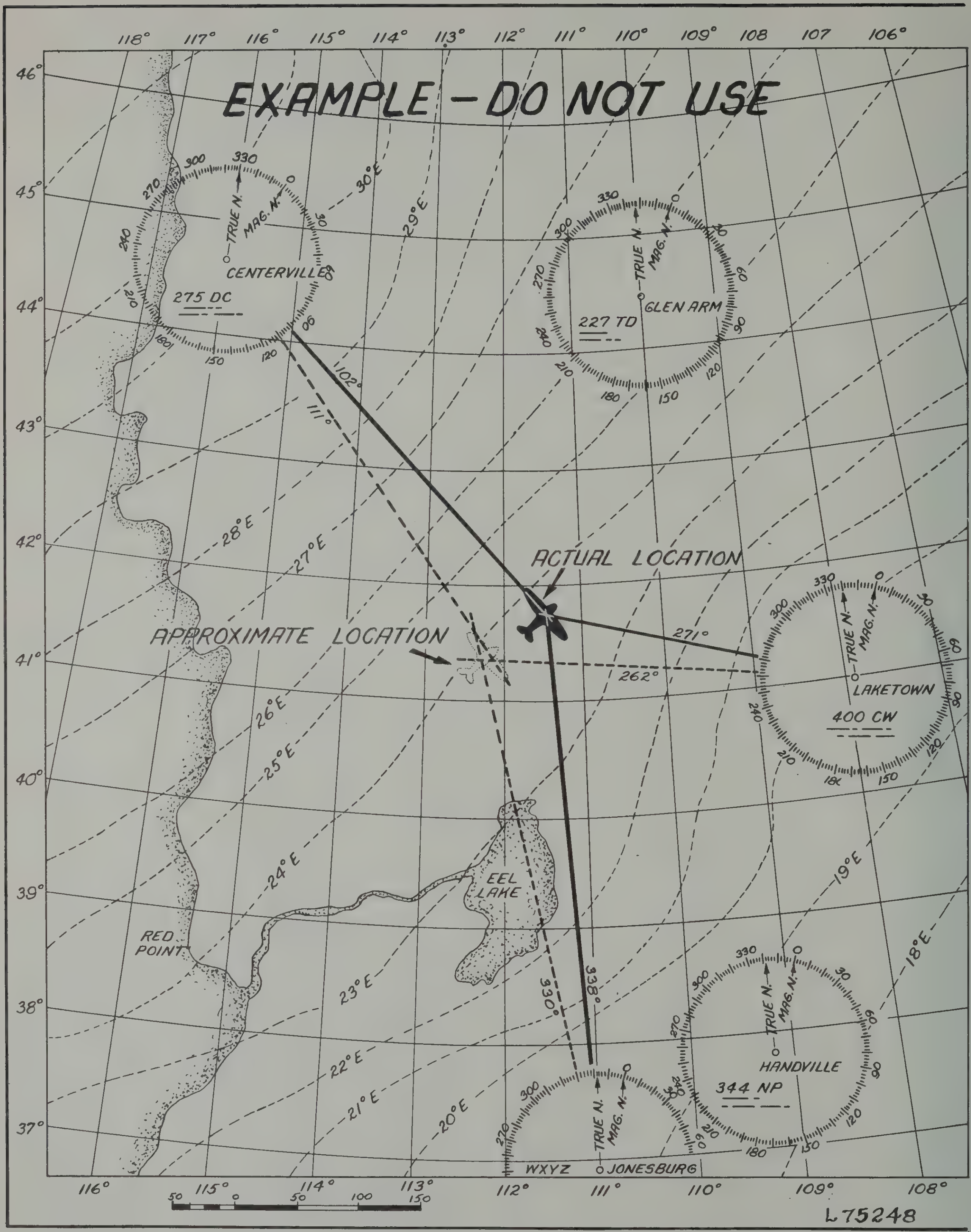


FIGURE 54 — PLOTTING LOCATION AND COURSE OF AIRCRAFT

correcting the radio bearings for meridian convergence of the chart and for the difference in magnetic variation at the aircraft and location of the radio station.

A location problem of this nature is shown in figure 54. For example; suppose the magnetic bearing from the aircraft may be 262 degrees to station "CW" at "Laketown", 330 degrees to "WXYZ" at "Jonesburg", and 111 degrees to "DC" at "Centerville". Plotting the reciprocals of these bearings results in a triangle, the center of which is the approximate location of the aircraft. Examination of the D/F chart (figure 54) shows that a correction for meridian convergence of about 4 degrees (112 − 108 = 4) must be added to the bearing for station "CW", since the aircraft is west of the radio station. The magnetic variation is 20 degrees east at station "CW", and 25 degrees east at the location of the aircraft; therefore the difference in magnetic variation of 5 degrees (25-20-5) must be added to the bearing, since the variation is greater easterly at the aircraft than at the radio station. A value of 268 degrees is obtained after these corrections have been applied, which is the true reciprocal of the magnetic bearing from station "CW" to the aircraft. These corrections for the three radio stations are listed in the following tables:

The meridian convergence corrections are as follows:

Radio Station	*Meridian (Approximate)*		*Meridian Correction*
	At Station	*At Aircraft*	
CW	108°	112°	+4°
WXYZ	111°	112°	+1°
DC	116°	112°	−4°

The magnetic deviation corrections are as follows:

Radio Station	*Magnetic Deviation (Approximate)*		*Magnetic Deviation Correction*
	At Station	*At Aircraft*	
CW	20°E	25°E	+5°
WXYZ	18°E	25°E	+7°
DC	30°E	25°E	−5°

The total corrections are as follows:

Radio Station	*Meridian Correction*	*Magnetic Correction*	*Total Correction*
CW	+4°	+5°	+9°
WXYZ	−1°	+7°	+8°
DC	−4°	−5°	−9°

The true bearings from the radio stations to the aircraft are as follows:

Radio Station	*Bearing (From Azimuth Indicator)*	*Total Correction*	*True Bearing (After Correction)*
CW	262°	+9°	271°
WXYZ	330°	+8°	338°
DC	111°	−9°	102°

When the bearings are plotted on the D/F chart the actual location of the aircraft is the intersection of the three lines, as illustrated in figure 35.

k. DIRECTION FINDING PRECAUTIONS.

(1) When only the pilot is present, set the bearing indicator pointer to zero index prior to take-off.

(2) No provision is made for COMP. operation on band III in Types MN-26M and MN-26Y.

(3) Select radio stations providing stable bearings. Tune equipment carefully. If an interfering signal is heard in the headset, it is probably causing an error in bearing. To check, tune a few kilocycles either side of maximum. A change in bearing with tuning indicates an interfering signal. The compass indicator needle must be held on course during this test and any change in bearing noted on the directional gyro. If it is not desirable to change the course of the aircraft, the loop drive can be rotated to recenter the compass indicator. If station interference exists, select another station, or proceed by other means of navigation until closer to the desired station. Care must be exercised when taking bearings on stations broadcasting the same program as they may be mistaken for each other. Avoid taking bearings on synchronized stations unless close to the desired station. If the radio station stops transmitting or fades, especially a station operating in a network, bearings might be taken on other stations of the same frequency (tuning dial setting), thus causing errors.

(4) Check dial calibrations against actual station frequencies.

(5) Do not operate with COMPASS control on maximum as the radio compass will be very sensitive to the least yawing of the aircraft. Reduce COMPASS control until 15-degree loop rotation produces full scale deflection on the left-right indicator.

(6) Do not depend on the tuning meter as a distance meter.

(7) Do not disturb any internal adjustments.

(8) Night effect, or reflection of radio waves from the sky, is always present. It may be recognized by a fluctuation in bearing. Try the following to eliminate night effect.

(*a*) Increase altitude, thereby increasing the strength of the direct wave.

(*b*) Take an average of the fluctuations.

(*c*) Select a lower frequency station. Night effect is worse at sunrise and sunset. Night effect is present on stations at 1500 Kcs at distances greater than 20 miles, and as the frequency decreases the distance increases until at 200 Kcs the distance will be about 200 miles. Satisfactory bearings, however, will often be obtained at much greater distances.

(9) When close to a station, accurate bearings cannot be taken with the aircraft in a steep bank. This is especially applicable to reception of signals from instrument landing trucks.

(10) Only head-on bearings are entirely dependable. When side bearings are taken, keep the wings horizontal.

(11) Do not depend upon two stations for a fix of location; at least three station bearings should be used. In general, a set of bearings spaced at approximately equal intervals throughout 360 degrees will give test accuracy.

(12) This equipment should provide compass bearings during conditions of moderate precipitation static which interrupt normal reception. The type of precipitation static existing in air mass fronts at different temperatures can be avoided by crossing the air mass front at right angles, and then proceeding on desired course instead of flying along the air mass front.

SECTION IV

MECHANICAL AND ELECTRICAL CHARACTERISTICS

19. THEORY OF RADIO COMPASS OPERATION.

In addition to its use as a radio communication receiver, the radio compass equipment may be used to guide the aircraft to transmitting station at its destination, or may be used to take bearings on transmitting stations as an aid to navigation. While the equipment is being used as a radio compass, the pilot and navigator can also hear the station signals and thus obtain weather reports or other flight information.

When the pilot wishes to fly the aircraft toward a transmitting station, that is, to use the equipment as a homing radio compass, the receiver is switched to COMP. operation and the station tuned in. A rotatable loop set with the azimuth scale in the zero position, provides directional characteristics. The volume (AUDIO) control and the indicator sensitivity (COMPASS) control are then adjusted, and the aircraft turned until the (left-right) indicator points to the center.

The compass indicator will remain at the center as long as the aircraft is headed directly toward, or directly away from, the transmitter (see figure 36), however, the behavior of the indicator will determine whether the transmitter is ahead of, or behind the aircraft.

If the transmitter is ahead and the aircraft is turned from the true course, the compass indicator will deviate from center. That is, when there is any departure from the true course the pilot can visualize the transmitter as being located on the side indicated by the pointer (see figure 55), and turning the aircraft in that direction will bring it back on course and the indicator back on center.

If the transmitter is behind the aircraft, the deviation is opposite, that is if the indicator deviates from center

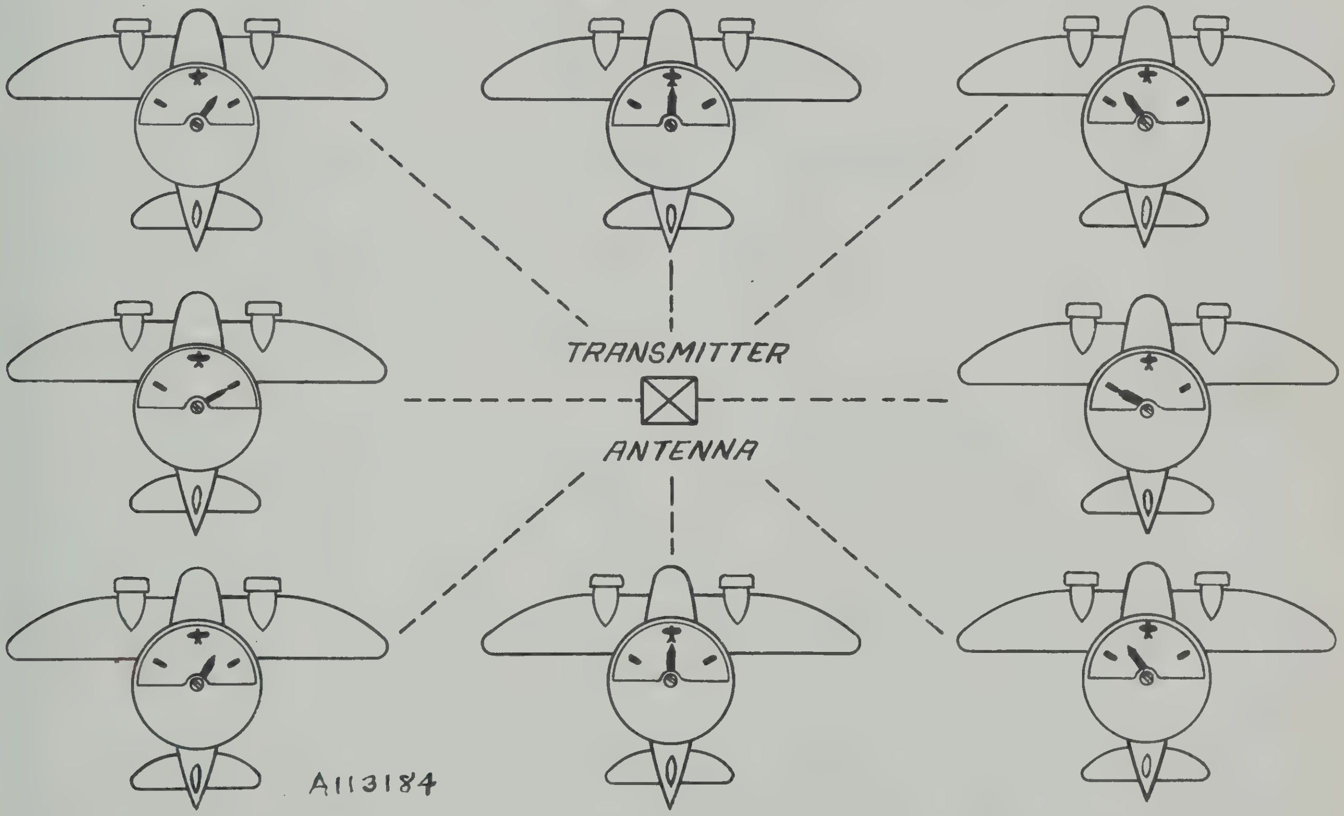


FIGURE 55 — TYPE IN-4A LEFT-RIGHT INDICATOR, FUNCTIONAL DIAGRAM

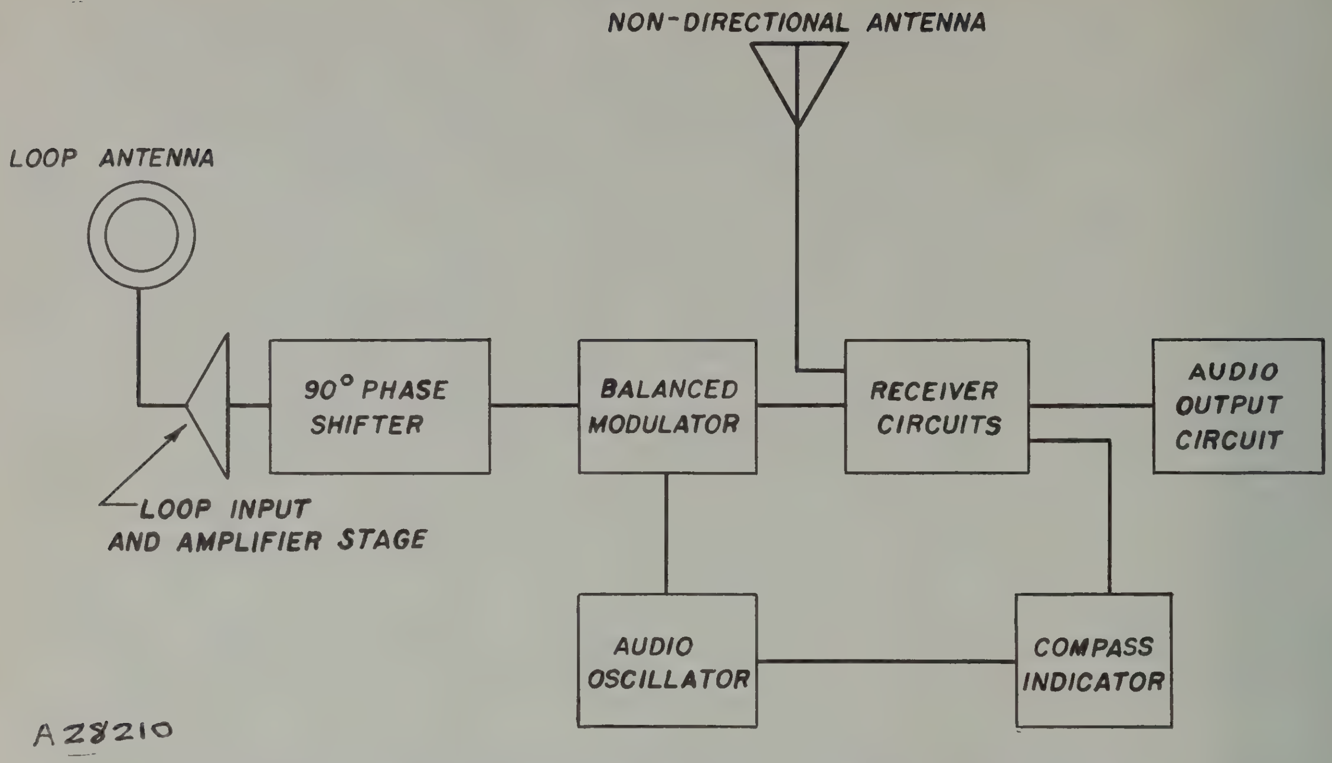


Figure 56 — Type MN-26 Radio Compass, Block Diagram of Circuit Functions

and the aircraft is turned in the direction indicated by the indicator, the deviation will increase, and the pointer will not return to center until the aircraft is turned through 180 degrees, and is headed toward the transmitter.

The indicator does not measure the course deviation in degrees. However, the indication is proportional to the deviation, and shows upon which side of the line of flight the transmitter is located, and remains on center only when the transmitter is in line with the axis of the aircraft. The sensitivity of of the compass indication is adjustable.

If the navigator wishes to take a bearing upon a transmitter, the loop is rotated until the compass indicator points to center, in which case the bearing of the transmitter with respect to the axis of the aircraft is shown on the azimuth indicator dial. The bearing of several transmitting stations may be taken in this manner in order to definitely establish the position of the aircraft. When bearings are thus taken, the equipment functions as a radio direction finder.

As shown in figure 56, the radio compass equipment consists of a loop antenna, a loop input and amplifier, a 90-degree phase shifter, a balanced modulator, and audio oscillator, a non-directional antenna, a sensitive and selective receiver, a compass indicator, and a telephone output circuit. The vertical antenna is non-directional, or is equally sensitive to radio signals from any direction. The voltage induced in a vertical antenna is in phase with the flux of the radio wave.

The loop antenna is directional in that the voltage induced in the loop is maximum when an edge of the loop is turned toward the transmitter, and is zero when the plane of the loop is perpendicular to the direction of travel of the radio wave from the transmitter. The resultant voltage induced in the loop is 90 degrees out of phase with the voltage induced in the vertical antenna, and changes abruptly 180 degrees, as the loop is rotated through the position of zero pick-up.

The voltage from the loop is amplified and shifted through 90 degrees so that it is either in phase with (0 degrees), or in phase opposition to (180 degrees) the voltage induced in the vertical antenna, depending upon which edge of the loop is turned toward the transmitter (see figures 57 and 58).

The voltage from the loop amplifier is then impressed upon the grids of the balanced modulator tube, which is actually two triodes combined into a single unit. The grids of the modulator tube are driven in phase opposition by the audio oscillator so that only one of the triode sections passes the loop signal at a time. Since the plates of the modulator tube are push-pull connected to the receiver circuits, they alternately add to, and subtract from, the voltage contributed by the vertical antenna. The addition of the loop signal to the

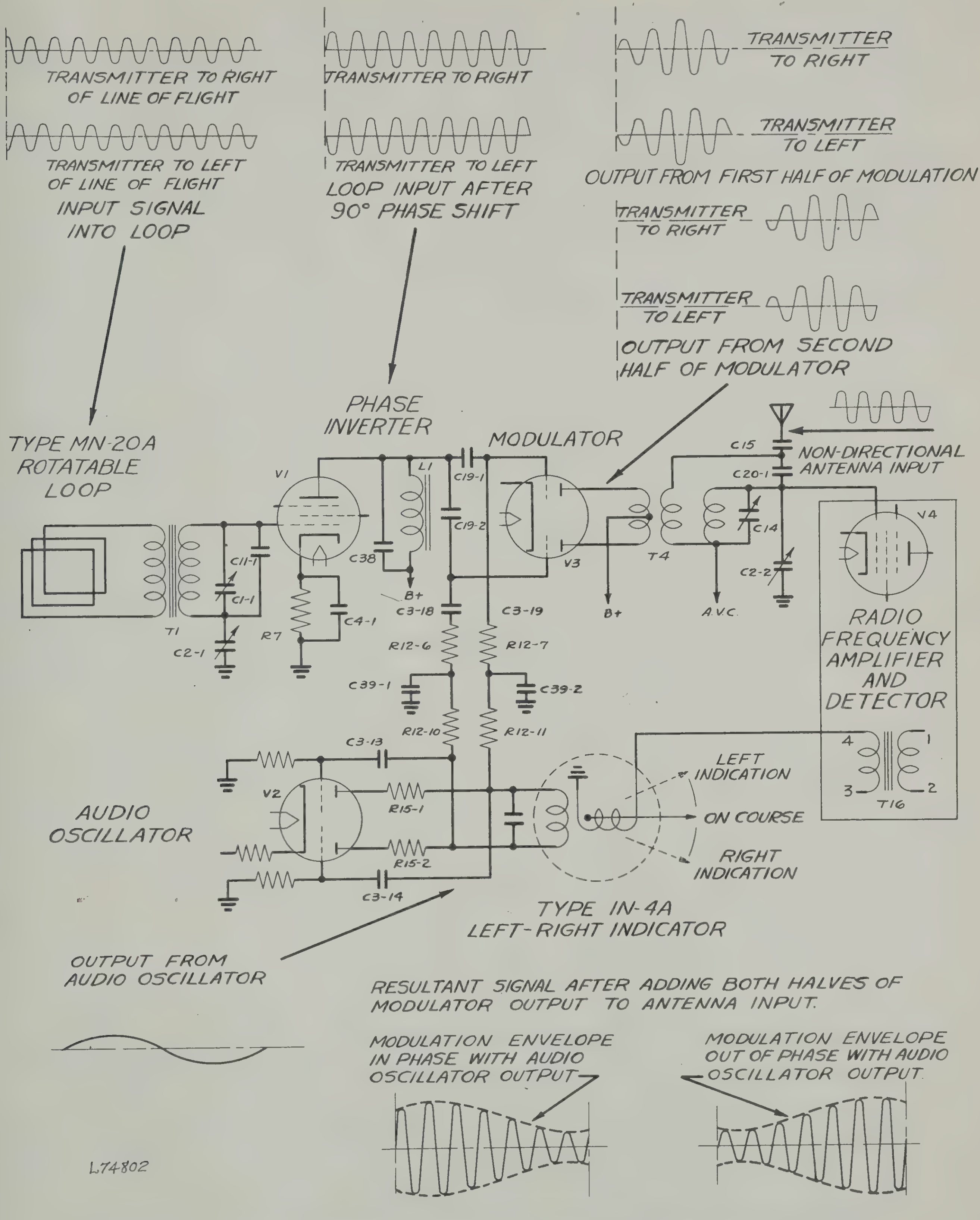


FIGURE 57 — TYPE MN-26 RADIO COMPASS, SIMPLIFIED SCHEMATIC, COMPASS OPERATION

signal from the non-directional antenna reverses in phase as the loop is rotated through a null position. The audio oscillator also provides the alternating current for the field of the dynamometer-type compass indicator (see figures 57 and 58).

The receiver circuit amplifies the combined signal, which is modulated at the audio oscillator frequency proportionally to the voltage contributed by the loop; moreover, the phase of the modulation reverses as the loop is rotated through a null. The modulated signal is then detected, amplified, and impressed upon the moving coil of the compass indicator (see figures 57 and 58).

The compass circuits are arranged so that if the radio signal is coming from the left, the modulation is such that the compass indicator pointer turns to the left; and if the radio signal is from the right, the compass indicator pointer turns to the right (see figures 57 and 58). When the signal is on the axis of the loop, the loop voltage is zero and there is no modulation of the carrier at the frequency of the audio oscillator, and the compass indicator pointer remains at the center.

The operation of the various compass elements can most easily be followed by refering to the simplified compass circuit, figure 57.

The voltage induced in the loop by a radio wave from the transmitter is coupled to the loop amplifier tube V1 through transformer T1 (when operating on Band I) or T2 (when operating on Band II). The parallel combination of L1 and C38 (in the plate circuit of V1) has a capacitive reactance at the signal frequency, so that the phase of the signal voltage is shifted 90 degrees (see figures 57 and 58) when impressed upon the grids of the modulator tube V3 through capacitors C19-1 and C19-2.

The fixed coil of the dynamometer-type compass indicator is tuned to resonance at 48 cycles per second, and serves as the tuned circuit of the audio oscillator tube V2. Since the compass indicator has an alternating magnetic field of 48 cycles per second, current in the moving coil at the same frequency, and in phase, will produce a deflection of the pointer toward the right of the center. If the phase of the current in the moving coil is reversed the deflection of the pointer will also reverse. Voltage from the audio oscillator is impressed upon the grids of the modulator tube sections in phase opposition through resistors R12-10, R12-11, R12-6 and R12-7 and capacitors C3-18 and C3-19. Due to its characteristics and because of the magnitude of the audio oscillator voltage impressed upon its grids, the modulator tube V3 functions as an electronic switch, permitting the loop voltage to pass through first one section, and then the other. Since the plates of the modulator tube are push-pull connector to transformer T4 (when operating on Band I) or T5 (when operating on Band II, the amplified loop voltage is added to the non-directional antenna voltage when one section of the modulator tube is functioning, and subtracted when the other section is functioning. The received signal is thus locally modulated at the frequency of the audio oscillator proportional to the voltage induced in the loop.

The signal is then amplified and the local modulation is detected and amplified to provide the 48-cycle per second energy for moving coil of the compass indicator. The phase of the voltage induced in the loop and the phase of the local modulation reverse as the loop is rotated through a null. This, in turn reverses the phase of the current in the moving coil of the compass indicator, and changes the deflection of the pointer from one side of center to the other.

The phase of the voltages acting in the modulator circuit for reception from the right and left are shown in figures 33 and 34. When the transmitter is located on the axis of the loop, there is no voltage induced and consequently no local modulation of the received signal.

20. DETAILED DESCRIPTION OF PRINCIPAL COMPONENTS.

a. TYPE MN-26 RADIO COMPASS.

(1) MECHANICAL.—Type MN-26 Radio Compass unit includes a cabinet, chassis, and mounting base. The radio compass unit contains the compass circuit elements, the superheterodyne receiver circuit elements, and the high voltage power supply. This unit also includes one set of vacuum tubes, one 6/32 socket type setscrew wrench, and 6 grid shield caps.

The radio compass receiver chassis is housed in a dust- and spray-proof cabinet formed of aluminum sheet and finished in grey wrinkle enamel. Slides in the base of the cabinet permit easy withdrawal of the chassis, which is held securely in place by a captive through-bolt running from the front panel of the chassis to a riveted nut in the back of the cabinet.

The mounting base consists of an aluminum base plate, with rubber shock absorbers mounted in the four corners.

The chassis of the radio compass receiver is formed of welded aluminum and is so constructed that when servicing the unit it may be placed on any of five sides without damage. A panel containing all of the cable terminations is attached to the front end of the chassis. All circuits are so shielded that after the equipment is aligned, the chassis may be placed in its cabinet without changing the alignments. The setscrew wrench is clipped to the middle chassis cross member. The subassemblies and other components on and under the chassis deck are arranged to provide the optimum in accessibility for maintenance.

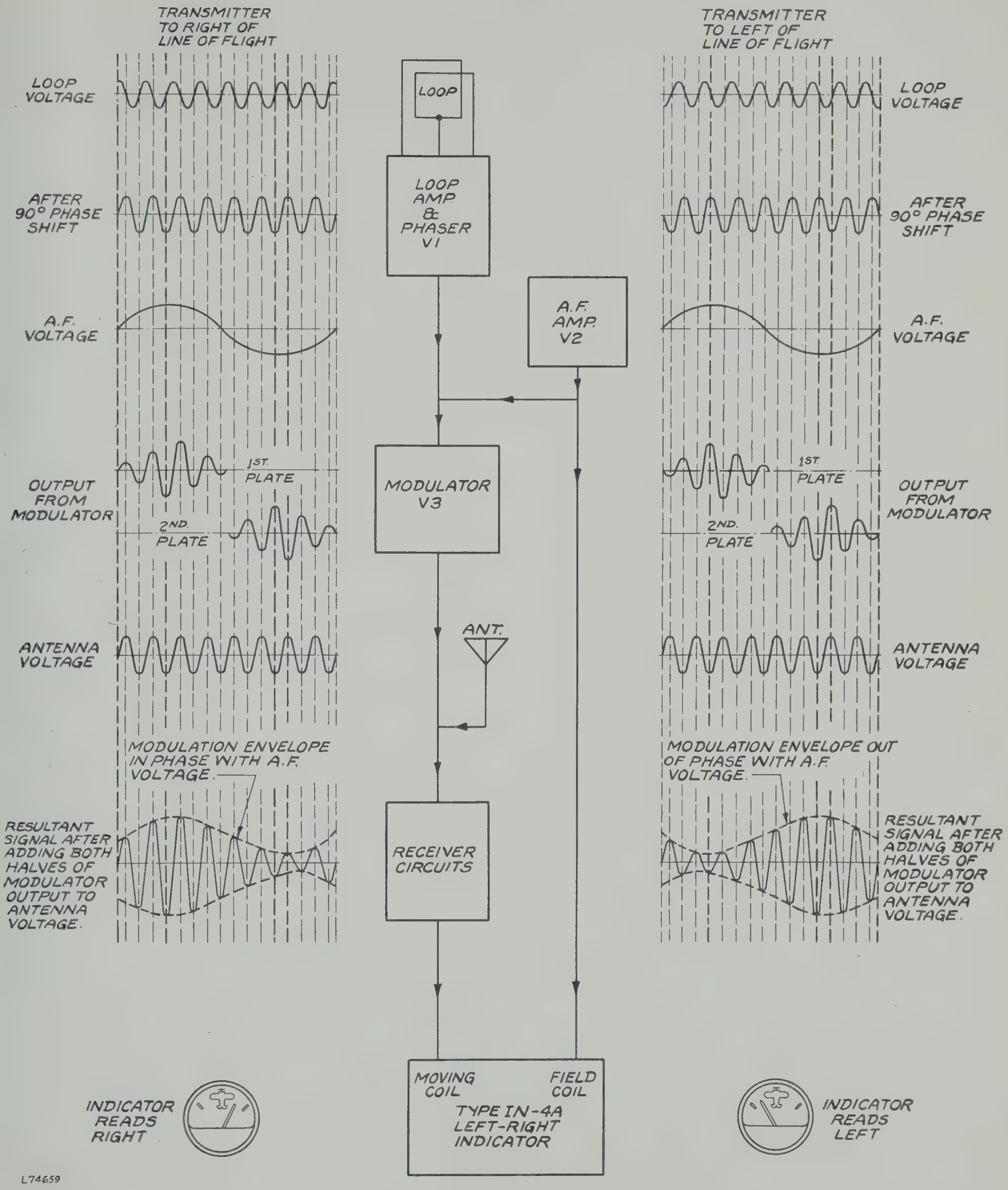


FIGURE 58 — FUNCTIONAL DIAGRAM, DEVELOPMENT OF MODULATION ENVELOPE

(2) ELECTRICAL—TYPE MN-26 SERIES Radio Compass comprises a compass circuit and a receiver circuit. The receiver may be operated with either a loop antenna or a non-directional antenna on all bands except Band III with Types MN-26M and MN-26Y. These types when operated in the Band III frequency range can be operated with a non-directional antenna only. The frequency range is covered in three bands as follows:

Radio Compass Type	Band I (Kilocycles)	Band II (Kilocycles)	Band III (Kilocycles)
MN-26A	150–325	325–695	695–1500
MN-26C	150–325	325–695	695–1500
MN-26CA	150–325	325–695	695–1500
MN-26M	200–410	410–850	3400–7000
MN-26W	200–410	410–850	850–1750
MN-26Y	150–325	325–695	3400–7000

Band selection is accomplished by a motor-driven band switch, the switch sections inserting into each circuit the coils for the desired hand and shorting out all unused coils, thereby preventing any resonant absorption circuits. The receiver circuit is of the superheterodyne type and consists of three stages of tuned radio frequency amplification (including first detector), a radio frequency oscillator and intermediate frequency amplifiers, a second detector and audio amplifier, an AVC circuit, an audio output amplifier, a compass output tube, and a CW beat frequency oscillator. A clearer idea of the following circuit description can be obtained by referring to figures 75 to 78. While the description traces only the circuit for Band I, it is applicable to other bands by substituting the appropriate coils for those bands.

The non-directional vertical antenna connects to a relay RE1, which performs two functions: When the COMP. or REC. ANT., the non-directional antenna connects directly through the relay contacts to the primary of T4, the antenna input transformer; when on REC.LOOP, the relay connections are arranged to ground the non-directional antenna and to substitute a capacitor C21-1 (100 mmf) or C43-1 (50 mmf) across the antenna primary winding of T4, the antenna input transformer. Resistor R18 connects directly to the antenna and permits electrostatic charges to leak off to ground when the antenna is ungrounded. The capacitor C15 prevents damage to the antenna transformer when a DC voltage is applied to the antenna. The primaries of T4 are inductively coupled to the secondary which is tuned by the second section of the ganged tuning capacitor C2-2. The grid of the 1st RF tube connects to the secondary of the transformer. A small neon tube between the grid and ground in the loop and antenna circuits protects tube and circuit elements against high antenna voltages which may result from operation of the airplane's transmitter or from high electrostatic charges on the antenna.

A coil L2 in the cathode lead of the 1st RF is resonated at 110.5 Kcs by capacitor C14-1 and acts as a trap circuit to attenuate unwanted signals near the intermediate frequency.

The plate of the first RF tube couples through transformer T7-1 to the grid of the second RF tube, the secondary of transformer T7-1 being tuned by the third section of the ganged tuning capacitor C2-3. An IF trap circuit L3, C14-2, in the cathode lead of the second RF tube, is tuned to 114.5 Kcs. The plate of this tube connects to the primary of transformer T7-2 the secondary of which is tuned by the fourth section of the ganged tuning capacitor C2-4 and connects to the control grid of V6, the third RF or first detector tube.

The injector grid of the first detector is excited by the output of triode oscillator tube V7 which is tuned 112.5 Kcs above the desired signal by the fifth section of the ganged tuning capacitor C2-5. The plate circuit of this detector tube is tuned to 112.5 Kcs, and couples inductively to the control of IF tube V8.

The plate circuit of IF amplifier tube V8 is tuned to 112.5 Kcs and is coupled inductively to a second tuned circuit, which connects to one diode rectifier plate of the second detector tube.

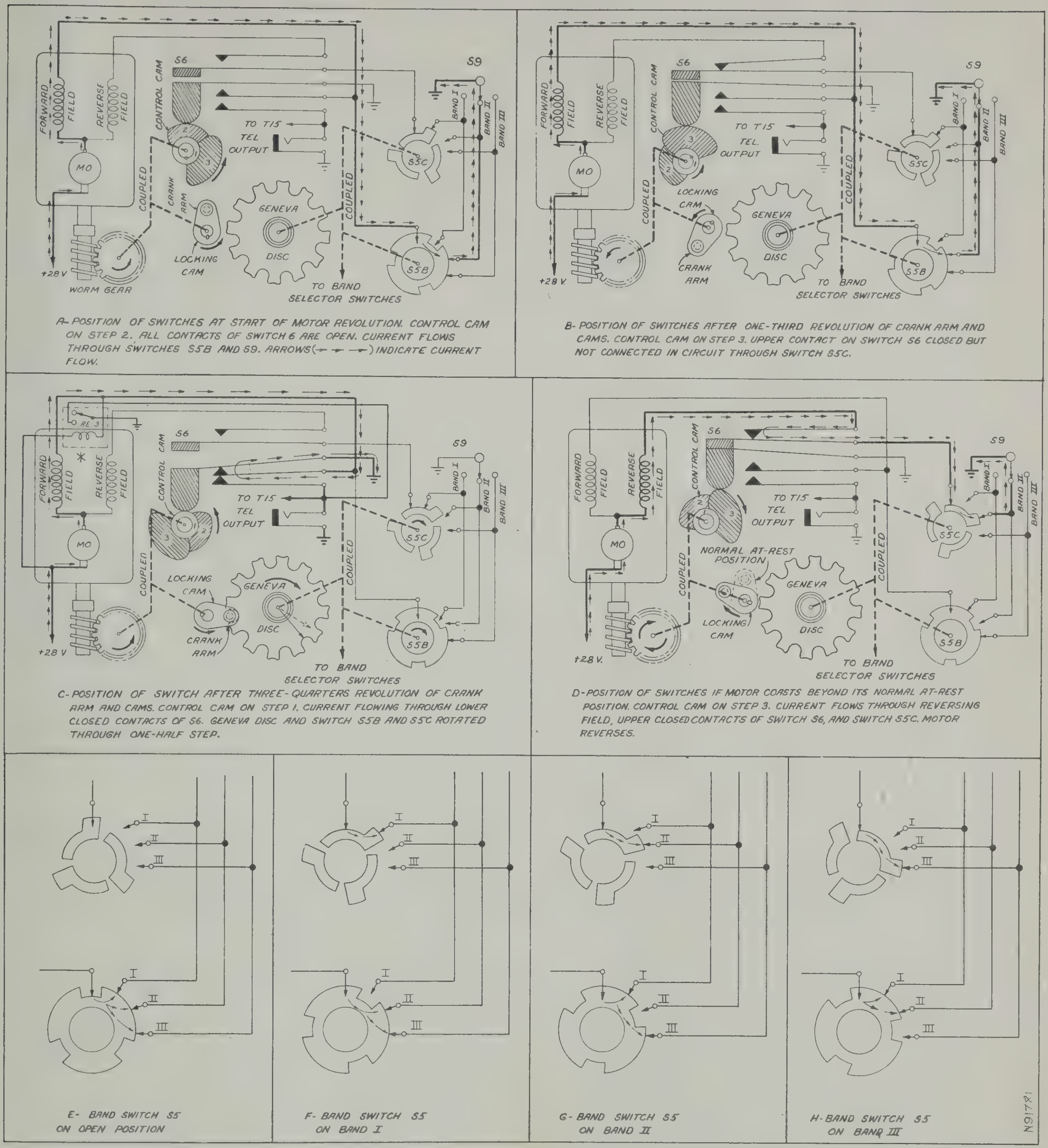
Output from the CW beat frequency oscillator V9 is coupled to the above mentioned diode plate. Operation of the tube V9 is controlled by S10, a toggle switch (C. W. ON-OFF) located on the remote control unit.

The grid of the second detector tube V10 receives the audio component of the rectified radio frequency signal at the junction of the diode load resistors R14-5 and R28.

The second diode plate is fed from the plate circuit of the IF tube through capacitor C21-4, and supplies AVC bias for tubes V4, V5, V6, and V8.

The greater the amplitude of the received signal, the greater will be the voltage built up across the AVC load resistor R22-4 by the rectified carrier. Since the control grids of the preceding tubes are connected to the negative end of the resistor, negative bias on them will be increased by a strong carrier, and because of their variable amplification characteristics, they will operate at reduced gain on such signals. Conversely, on weak signals the bias introduced by the AVC will be smaller and the tubes will operate at higher gain. This action tends, therefore, to maintain incoming signals at a constant level.

The plate of the second detector tube is resistance-capacitor coupled to the grid of the audio output tube



* NOTE: RE-3 A NOISE SILENCING RELAY HAS BEEN ADDED TO MN-26 EQUIPMENT SINCE DECEMBER 1943

Figure 59 — Functional Diagram, Band Switch Motor Operation

V11 and compass tube V12. The plate of this output tube is connected to the primary of output transformer T15. The secondary of this transformer is tapped for connection to 600-ohm or 4000-ohm output circuits. The output of transformer T15 is connected to the headset jacks J1 and J2.

The plate of the compass output tube V12 is connected to the primary of transformer T16. The secondary of T16 is connected to the IN-4 Indicator.

(3) BAND CHANGE CIRCUIT.—Band changing is affected by switching the tuned circuits in the LOOP, ANTENNA, RADIO FREQ.-1, RADIO FREQ.-2 and OSCILLATOR stages by means of motor driven switches.

The motor armature drives a worm gear which is ganged to a common shaft with the crank arm and locking cam, and the control cam (see figure 59A). The crank arm drives the geneva disc which is ganged on a second common shaft with the positioning switches S5B and S5C (see figure 59C), and with the band selector switches. The control cam operates switch S6.

When the remote control unit band selector switch is operated to select a different band, the band switch motor MO is energized by completion of the circuit to ground through the contacts of switches S9 and S5B (see figure 59A). The motor drives the crank arm through one, two, or three complete revolutions (see figure 59C) which steps the geneva disc a notch at a time until the motor is deenergized. Figure 59A illustrates the positions of these controls when the band changing is complete, except the switch S9 would be on another contact and no current would be flowing.

Exact control of the position is obtained by the control-cam-operated switch S6. When the motor is at rest, the arm of switch S6 is on step 2 of the control cam, and all contacts are open. When the motor starts, the arm is first raised by step 3 of the cam (position as in figure 59B), closing the upper contacts, which at this time perform no function since the circuit between S5C and S9 is open. As the motor continues operating, the arm of S6 will drop down to step 1 of the cam (see figure 59C), opening the upper contacts and closing the lower ones. The closing of the lower contacts provides an additional path to ground to keep the motor energized after the opening of S5B by the movement of the geneva disc, and also grounds the audio output of the radio compass to prevent "clicks" while changing bands (see figure 59C).

On recent models of the MN-26 Series an M-3 SPDT Relay (A114293), 320 ohms, has been *added* to completely ground the audio circuit when band changes are being made, thereby eliminating all noise. Some noise was still present with the previous arrangement. No change was made in the original audio grounding circuit. When the crank arm has been driven past the geneva disc, engaging the locking cam with the arc of the disc, the control cam raises the arm of the S6 to step 2, opening all contacts, and the motor coasts to a stop. If it should coast past step 2, the upper contacts of S6 will be closed by the control cam and will now energize the reverse field of the motor through the contacts of S5C and S9 (see figure 59D), and the motor will reverse to the proper position until all contacts of S6 are open.

The number of revolutions required by the crank arm will depend upon the relative positions of switches S5B, S5C, and S9 at the start of motor revolutions, because the switch S5 moves in only one direction (see figures 59E, 59F, 59G, and 59H). If the switches are at rest on Band III (see figure 40H) and the switch S9 is placed on Band II, the switch will have to advance three places (figures 59E, 59F, and 59G) before the motor will again stop. If, however, the switches are at rest on Band II (see figure 59G) and the switch S9 is placed on Band III, the switch need only advance one step (see figure 59H) to open the motor contacts.

(4) SIDETONE CIRCUITS.—A portion of the audio voltage from a transmitter may be fed to the audio input circuit of the radio compass for purposes of monitoring transmissions.

Relay RE2 is connected into the grid circuit of the audio amplifier tube V11 to allow input from either the receiver circuits or the transmitter sidetone circuits. The unoperated position of the relay provides continuity of the output circuits. The operated position of the relay opens the cathode bus and connects the externally applied (approximately 1.5 volts) voltage to audio amplifier tube V11. Voltage for operation of the relay selenoid is obtained from the radio compass primary voltage and is controlled by connecting the transmitter push-to-talk switch to the negative and positive sidetone leads. All connections to the sidetone relay circuit are to be made in the junction box.

b. TYPE MN-28 REMOTE CONTROL (see figures 60, 61, and 62).

(1) MECHANICAL.—The three bands are calibrated on one dial and the bands which are not in use are covered by a mask. This mask is attached to the switch which selects the band.

(2) ELECTRICAL.—Type MN-28 Remote Control electrically controls the operation of Type MN-26 Radio Compass. The controls function as follows:

(*a*) FUNCTION SWITCH (see figure 60).—When the OFF position switch S8A opens the circuit between the 28 volt primary power source and the circuit components of the radio compass equipment and

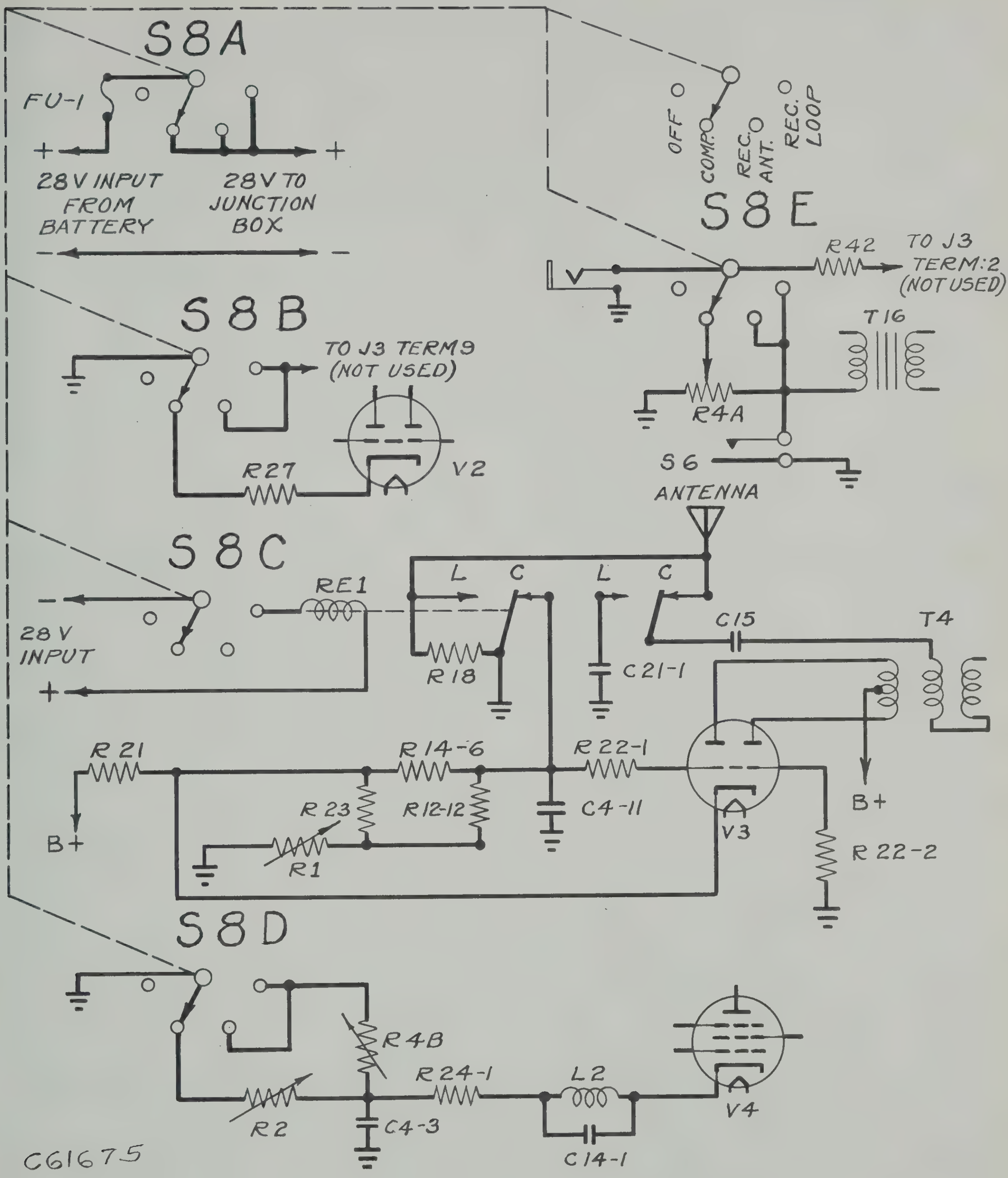


Figure 60 — Functional Diagram, Function Switch S8

NOTES:

A- SNAP SWITCH COUPLED TO SHAFT OF S8. "OFF" IN POSITION 1, "ON" IN ALL OTHER POSITIONS OF S8.

B- FOR 14 VOLT OPERATION, A JUMPER (SHOWN BY A BROKEN LINE) MUST BE ACROSS SECTION "B" OF RESISTOR R35-3.

C- IN TYPES MN-28G AND MN-28X, RESISTOR R42 IS NOT USED AND TERMINAL "2" IS CONNECTED TO JACKS J1 AND J2.

D- THE FOLLOWING TABLE LISTS THE VALUES OF RESISTORS R4A AND R42:

REMOTE CONTROL TYPE	RESISTANCE (OHMS)	
	R4A	R42
MN-28A	2000	NOT USED
MN-28C	2000	250
MN-28G	25,000	NOT USED
MN-28NA	2000	250
MN-28X	2000	NOT USED
MN-28Y	2000	250

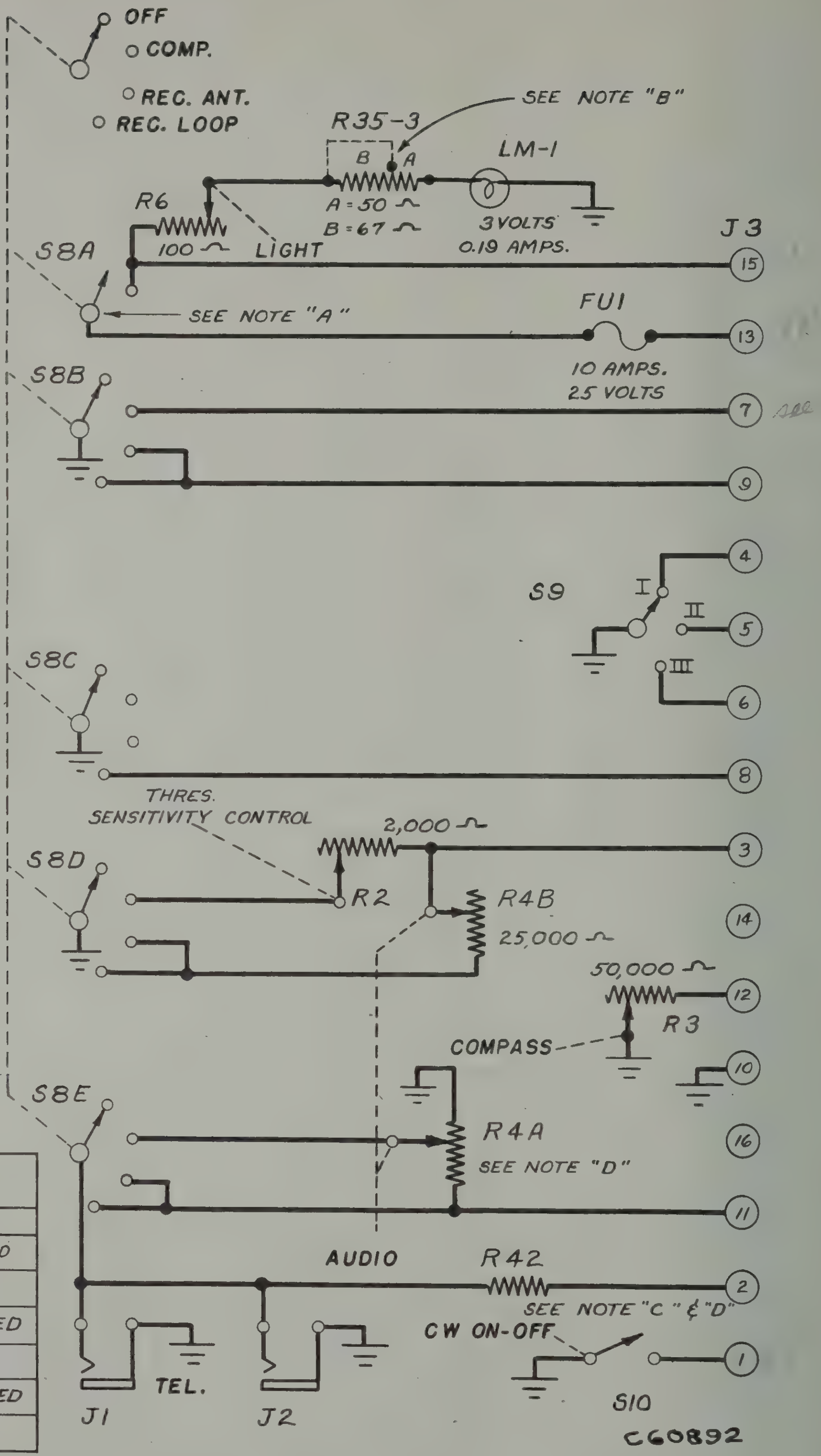


FIGURE 61 — TYPE MN-28 REMOTE CONTROL, SCHEMATIC CIRCUIT DIAGRAM

operation ceases. When in the COMP. position switch S8B places resistor R27 into the cathode circuit of the audio oscillator tube V2 which causes this tube to operate, switch S8D places the COMPASS control R2 into the cathode of tubes V4, V5, and V6 (1st and 2nd RF and 1st Det) permitting control of the threshold sensitivity, and switch S8E places section R4A of the AUDIO control between the output transformer T16 and the TEL. jacks, to control the audio level. When in the REC.ANT position switch S8D places section R4B of the AUDIO control in the cathode circuit of tubes V4, V5 and V6 in place of R2 and switch S8E places the output transformer T16 directly into the TEL. jack in place of section R4A of the audio control. When in the REC.LOOP position switches S8D and S8E perform the same functions as when in the REC.ANT. position and in the REC.LOOP position switch S8C operates relay RE1. Relay RE1 removes the antenna from the receiver elements and grounds it, and opens the ground connection from the junction of resistors R22-1 and R14-6 causing one side of tube V3 to become inoperative. Tube V3 functions as a balanced modulator with switch S8 in the COMP. position, as a triode amplifier in the REC.LOOP position, and is inoperative in the REC.ANT. position.

(*b*) BAND SWITCH.—The operation of the band selector switch S9 is described in section IV, paragraph 20*a*(3).

(*c*) AUDIO CONTROL.—The AUDIO control regulates the level of the audio signal in the headset. This control is a dual potentiometer (R4A and R4B) connected in the headset and r-f amplifier cathode circuits. When functioning as a compass (function switch S8 on COMP), the equipment is operating on automatic volume control and by varying this control section R4A determines the audio level (or volume) in the headset. When the equipment is operating as a receiver (function switch on REC.ANT. or REC.LOOP) this control (section R4B) varies the gain of the r-f amplifiers, permitting radio range reception.

(*d*) THRESHOLD SENSITIVITY CONTROL.—This control is welded on the back of the COMPASS control R3, and access to this control is possible only by removal of the base of the remote control. At the time of installation the function switch is placed on COMP. and the threshold sensitivity control R2 is adjusted to limit the gain of the r-f amplifiers to prevent erratic fluctuation of Type IN-4 Left-Right Indicator due to noise. Instructions for setting this control are described in section II, paragraph 11.

(*e*) COMPASS CONTROL.—The COMPASS control R3 regulates the extent of pointer deflection of Type IN-4 Left-Right Indicator by varying the gain of the compass output tube V12. Resistors R3 and R19-1 provide grid bias for tube V12.

(3) COMPARISON OF REMOTE CONTROLS.—The following table lists the differences between the various remote controls which may be used with the MN-26 radio compasses which are described in this book.

Type Number	*Output Impedance*	*Resistance (Ohms)*		*Frequency Range*
		R4A	*R42*	
MN-28C	600Ω	2000	250	150–1500 kcs
MN-28G	4000Ω	25,000	Not used	150–1500 kcs
MN-28NA	600Ω	2000	250	200–850 kcs and 3.4–7.0 mcs
MN-28X	600Ω	2000	Not used	200–1750 kcs
MN-28Y	600Ω	200	250	150–695 kcs and 3.4–7.0 mcs

Besides the physical differences shown in the preceding table, there are slight differences in wiring as follows: In Types MN-28C, MN-28NA, and MN-28Y, the audio output terminal 2 is connected through the resistor R42 to jacks J1 and J2. The Types MN-28G, and MN-28X are similar to Types MN-28C, MN-28NA, and MN-28Y except that resistor R42 is eliminated and terminal 2 is directly connected to jacks J1 and J2 (see figure 61).

The remote controls may be used with either 14 or 28 volt sources by connection or removal of the jumper across section B of resistor R35-3.

Section I, paragraphs 2*a* and 2*b* lists the proper remote control to be used with various MN-26 radio compasses.

c. TYPE IN-4A LEFT-RIGHT INDICATOR (see figures 9 and 63.—The indicator is a stationary iron-core dynamometer type meter which indicates the direction of incoming radio waves with respect to the plane of the loop antenna. When correctly interconnected to other components of the MN-26 radio compass equipment, the center-tapped field coil serves as the plate inductance for the 48 cycle audio oscillator tube V2, being resonated by a capacitor mounted inside the case. As shown in figure 63, terminals 2 and 4 of the receptacle connect to the moving coil and terminals 1, 3, and 5 connect to the field coil.

As shown in figure 63, it is necessary to connect the field resonating meter load assembly (AA18823-1) into the junction box across terminals 3 and 5 of plug P5.

d. TYPES MN-20 AND MN-24 ROTATABLE LOOP.—The loop consists of a center-tapped coil of wire enclosed in an electrostatic shield and a means of being rotated from a remote point.

The differences between the various models available for this equipment are as follows:

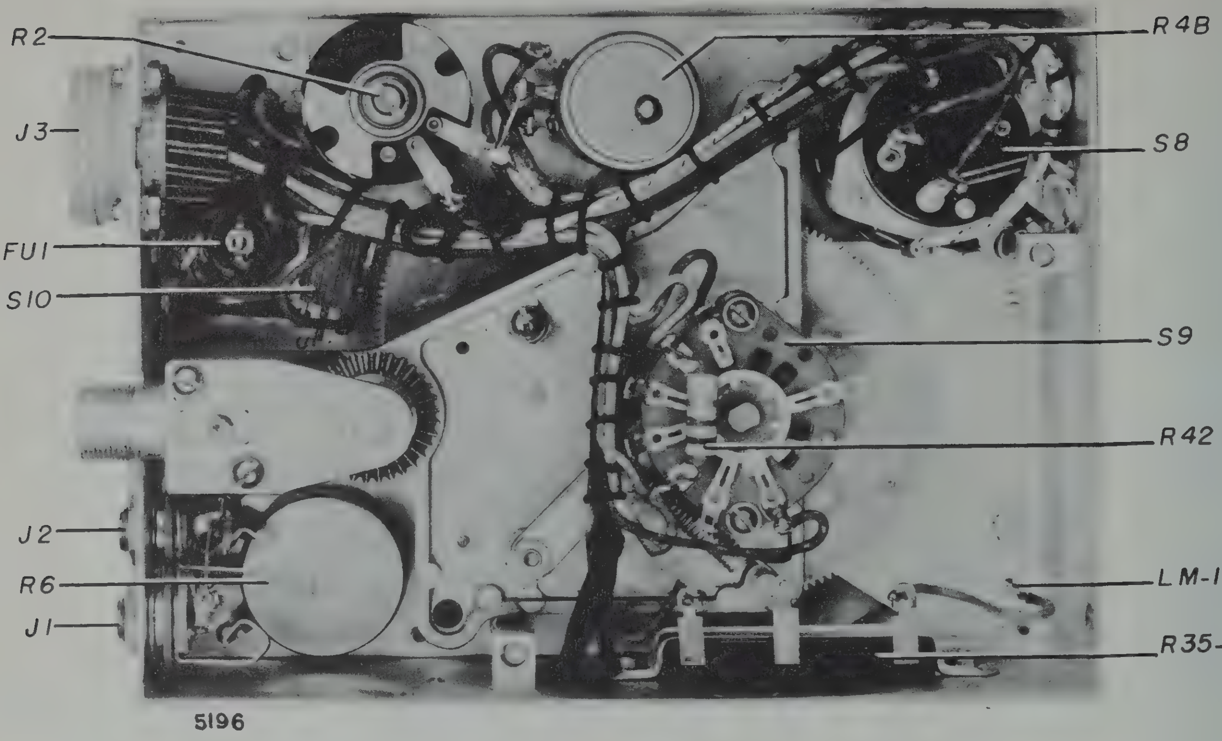


FIGURE 62 — TYPE MN-28 REMOTE CONTROL, INTERIOR VIEW

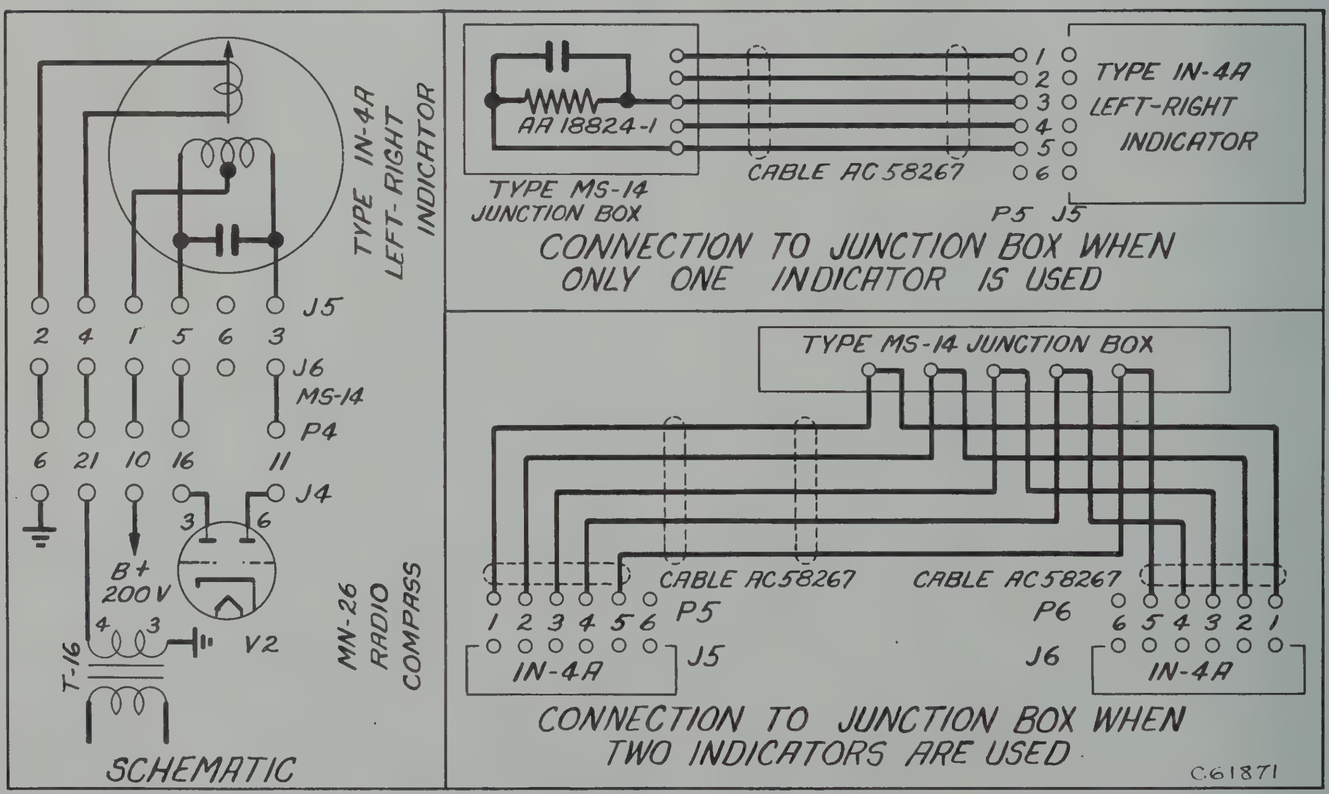


FIGURE 63 — TYPE IN-4A LEFT-RIGHT INDICATOR, SCHEMATIC CIRCUIT DIAGRAM

(1) TYPE MN-20 ROTATABLE LOOP.—The diameter of the loop is nine inches and the loop is equipped with a right angle drive fitting. Placing the loop drive fitting into one of the openings in the loop base adapts the loop for mounting on the top of the aircraft while placing the fitting in the other opening adapts the loop for mounting under the aircraft. A cover plate is provided for covering the opening which is not used.

(2) TYPE-MN-20C ROTATABLE LOOP.—The Type MN-20C is identical to the Type MN-20A except that it has a straight fitting in place of a right angle fitting.

(3) TYPE MN-20D NON-ROTATABLE LOOP is a fixed installation and is used for homing operations only. Diameter of loop is 9 inches.

(4) TYPE MN-20E ROTATABLE LOOP.—The MN-20E is similar to the MN-20C except that it has two-straight-type loop drive fittings which simplifies installation. The Type MB-52A Right Angle Drive may be used with the MN-20E to permit right angle approach of the mechanical cable.

(5) TYPE MN-24A ROTATABLE LOOP.—The Type MN-24A is similar to the Type MN-20A except that the loop diameter is 18 inches.

(6) TYPE MN-24B ROTATABLE LOOP.—The Type MN-24B is similar to the Type MN-20C except that the loop diameter is 18 inches.

(7) TYPE MN-24C ROTATABLE LOOP.—The type MN-24C is similar to the Type MN-20E except that the loop diameter is 18 inches.

e. TYPES MN-22A AND MN-40D AZIMUTH INDICATOR.—Essentially the azimuth indicators consists of double ended tachshaft drives to which are connected, through an appropriate gear and cam drive, a pointer that moves in a horizontal plane against the indicator dial. The azimuth indicators are designed for use with standard aircraft tachometer shafts (AA15410-1) and any loop having a gear drive reduction of 120:1 between loop and tachshaft.

Two instrument lamps (A18881-1) provide illumination. These lamps are connected in parallel with one side grounded, and require a 3 volt, 0.38 d-c source which can be connected to the unit by means of a Breeze plug number 1002-15-10 (AB9487).

The azimuth indicators are equipped with compensators which, when properly adjusted, permit reading the true bearing of the source of the received signal.

(1) TYPE MN-40D AZIMUTH INDICATOR.—A cam strip is located in the cam housing assembly and is provided with an adjusting screw (through the cam housing assembly) at each 15 degrees around its periphery. The compensator which is controlled by this cam strip automatically applies the aircraft error correction to the indicator pointer. The scale which is visible through the small opening in the lower center of the indicator face is used as a reference scale when the aircraft error compensators are being adjusted.

The heading of the aircraft relative to magnetic North, and any necessary East or West variation correction is applied by moving the azimuth scale the proper number of degrees relative to the fixed index mark by means of the variation knob.

(2) TYPE MN-22A AZIMUTH INDICATOR.—Connected to the internal gearing is a circular cam scribed with nine circles and twenty-four radial lines corresponding to degrees correction and degrees azimuth rotation respectively. The cam may be cut to any required shape to meet the particular installation and can accommodate a maximum error of plus or minus 20 degrees. As supplied the cam introduces no correction and can, if no error correction is required, be used without further adjustment.

The Type MN-22A Azimuth Control provides means for obtaining Loop rotation and bearings (indications of loop settings corrected for quadrantal error) as follows:

(*a*) Bearing relative to ships heading are read on the outer fixed dial.

(*b*) Magnetic bearings are read under the pointer on the inner movable dial, after the number on this dial, which corresponds to the airplane's magnetic course, has been set at the zero mark on the fixed dials.

(*c*) True bearings are read under the pointer on the movable dial after the number on this dial, which corresponds to the airplane's magnetic course, has been set opposite the east or west compass variation shown on the inner fixed dial.

(*d*) Reciprocal bearings can be read at the opposite end of the pointer.

(3) TYPE MN-52G or TYPE MN-52J AZIMUTH CONTROL is designed for mounting on the instrument panel or alongside of the pilot. (See fig. 17 for mounting dimensions.) It has a dial calibrated to give direction readings to 2.5 degrees and readings to one degree are readily obtained by interpolation. The dial is illuminated by a pilot light (LM-2), which is turned on or off by the LIGHT Toggle Switch S-11.

The dial pointer is crank operated through a set of three mitre gears driving a worm gear, which in turn drives a gear mounted on the dial pointer shaft. The same set of three mitre gears also drives one end of the standard tach shaft coupling to the loop and by virtue of a 1:1 gear ratio applies the same force to the loop mechanism as that applied to the crank.

The off-zero warning light incorporated in the Type MN-52J Azimuth Control is omitted in the Type MN-52G.

SECTION V
MAINTENANCE

21. ROUTINE INSPECTIONS.

a. PRE-FLIGHT INSPECTIONS.—Regular inspections should be made preceding each flight as follows:

(1) All interconnecting cables should be checked to see that they are securely locked in their receptacles.

(2) Check airplane battery with a hydrometer.

(3) Check operation of the voltage regulator on the charging generator, adjusting same to insure consistent operation of the generators at 28 to 30 volts.

(4) Clean antenna insulators, especially any which may be exposed to engine exhaust or propeller blast.

(5) Check connections of lead-in wires, both at antenna and radio compass ends.

(6) Check all instrument lamps.

(7) If radio compass is functioning properly with power supply "background noise" at a suitable low level, do not disturb the power supply unit.

(8) Each inspection should include a listening test made on at least one point in each band. Operation of all controls should also be checked. Any major trouble should be apparent from these tests.

b. PERIODIC INSPECTION

(1) GENERAL—APPLICABLE TO ALL PARTS. —Inspect all nuts, bolts, and screws for looseness. Do not tighten or loosen glyptalled screws or nuts unless it is evident they are loose. In the event they are, remove screws or nuts, glyptal, replace and tighten. Remove loose solder, dirt, and metallic chips. Clean equipment thoroughly and touch up scratched paint. Inspect soldered joints. Inspect wiring. Inspect all plug connectors and clean if necessary.

c. TYPE MN-26 RADIO COMPASS.—Inspect unit as described in section V, paragraph 21.*b.* but do not disturb alignment adjustment. Do not disturb wiring unless necessary. Check all tubes. If the tube plate current is less than 80% of normal plate current with 6.3 volts on heater, replace the tubes. Replace all tubes used over 500 hours.

(1) DYNAMOTOR DYN.—The dynamotor should be inspected after 500 hours of service or once a year, whichever period is shorter. Examine the brushes to see if they have worn properly and are free of hard spots. If such spots are apparent, renew the brush. Spotted brushes can be located by inspecting the commutator for grooves. Remove bearings from armature, clean with penetrating oil and carbon tetrachloride. Check bearings for tolerance and broken or chipped balls. Clean away all old grease and relubricate. Wipe off dirt from commutator, end bells, armature, and housing. If commutator does not have a smooth, even surface, place the armature in a lathe and rotate it. Polish the faulty commutator with a piece of soapstone or take a very thin (.003 inch) cut on a lathe. Do not use sandpaper as this causes deformation of the commutator bars. *Do not use emery cloth.* Remove all dust and dirt particles after polishing. A commutator should have a smooth, polished surface free of dirt, grease or ridges. *A commutator having a smooth or polished surface should not be turned down simply because it is discolored.* Under normal conditions, the commutators should not require turning down before the expiration of 5000 hours of service. After turning down, the commutators should be carefully examined to see if undercutting of mica is necessary. A small brush, such as a toothbrush, should be used to remove any foreign particles that remain between the commutator bars.

(2) TUNING CAPACITORS.—Inspect for dirt between plates. *Carefully* clean with a pipe cleaner. *Do not bend plates. Do not lubricate.* Do not blow out, as air hose may contain water and have sufficient pressure to bend the plates. For tuning mechanism, remove all dirt and old grease. Lubricate gear and tuning shaft coupling as specified in section V, paragraph 24.

d. TYPE MN-28 REMOTE CONTROL.—Inspect as indicated in section V, paragraph 21.*b.* Clean and lubricate dial tuning mechanism and tuning shaft coupling as in section V, paragraph 24.

e. TYPE MN-20A ROTATABLE LOOP.—Clean off all grease and dirt. Relubricate if necessary as specified in section V, paragraph 24.

f. TYPE IN-4 LEFT-RIGHT INDICATOR.—Inspect visually. Replace faulty indicators. Do not open inner case. A faulty capacitor can be replaced by removing outer case only. Repairs of indicators should only be done by competent personnel at authorized instrument repair shops.

g. TEST PERFORMANCE.—Reassemble equipment and measure performance as described in section V, paragraph 28. Vibrate equipment and note any increase in noise or clicks with and without RF input. If equipment is noisy or fails to meet performance requirements, re-examine the equipment until the trouble is discovered.

h. WIRING.—Inspect bonding in aircraft. Inspect dynamotor. Reassemble equipment. Inspect antenna lead-in. Make replacements wherever necessary. Inspect the loop mounting for proper bracing.

Repeat operational inspection of section V, paragraph 21.*a*.

22. RADIO COMPASS UNIT ALIGNMENT (See figure 64).

This equipment has been carefully adjusted and aligned by the manufacturer and thoroughly inspected before shipment. The circuits are designed so that the alignment will be maintained over long periods of time. Before changing any adjustments it must be ascertained that the difficulty is not the result of normal deteriorating influences such as worn out vacuum tubes, blown fuses, improper operating voltages, broken cords, external RF interference, etc. FACTORY ADJUSTMENTS SEALED WITH PURPLE GLYPTAL ARE NOT TO BE ALTERED UNLESS ABSOLUTELY NECESSARY. Any questionable performance characteristics should be measured in accordance with section V, paragraph 28 before and after adjustments. All aligning adjustments are accessible from the top of chassis (see figure 64) and are:

Band	*Alignment Frequency*				*Can Adjustments (All Models)*				
	MN-26A, MN-26C, MN-26CA	*MN-26M*	*MN-26W, MN-26X*	*MN-26Y*	*Loop*	*Antenna*	*Radio Freq-1*	*Radio Freq-2*	*RF Osc.*
I	325	410	410	325	C1-1	C1-4	C1-7	C1-10	C1-13
II	695	850	850	695	C1-2	C1-5	C1-8	C1-11	C1-14
III	1500	7000	1750	7000	C1-3*	C1-6	C1-9	C1-12	C1-15

* Not used in Types MN-26M and MN-26Y.

a. INTERMEDIATE FREQUENCY AMPLIFIER ALIGNMENT (See figure 64).

(1) SECOND IF STAGE ALIGNMENT.

(*a*) Operate on REC. ANT. and plug a 600-ohm output meter, (or 4000-ohm) as needed, in J1 with other jack open. Set AUDIO on maximum. Set tuning dial to 695 kcs (or 850 kcs) on Band II.

(*b*) Apply a 112.5 kcs signal, 30% modulated at 400 cycles, directly to the grid of the i-f tube V8, leaving the regular grid clip in place. The signal generator output should be adjusted to about 100,000 microvolts.

(*c*) Adjust L12 and L13 of T14 for maximum output, reducing the signal generator voltage as necessary to keep the output of the radio compass unit at approximately 50 milliwatts. The input to tube V8 when T14 is properly aligned should be between 25,000 and 40,000 microvolts.

(*d*) While the signal generator is at exactly 112.5 kcs, turn off modulation and turn c-w switch ON. Adjust coil L6 for zero beat. The c-w oscillator will then oscillate at the i-f frequency and the zero beat method of aligning the r-f oscillator stage may be employed. After completion of alignment, the c-w oscillator should be readjusted to 113.5 kcs for the 1000-cycle per second difference frequency.

(2) FIRST I-F STAGE ALIGNMENT

(*a*) With the dial still turned to 695 kcs (or 850 kcs) on Band II, AUDIO control turned fully clockwise, and OFF-COMP.-REC. ANT.-REC. LOOP switch on REC. ANT. position, attach the lead from the signal generator to the grid of the first detector tube V6 through a 0.5 Mfd capacitor, removing the regular grid clip, and shunt the grid of the first detector tube V6 with a 500,000-ohm resistor. Adjust the signal generator to 114.5 kcs, 30% modulated at 400 cycles and an output of 1000 microvolts. Adjust L10 and L11 for maximum output. Reset the signal generator to a frequency of 110.5 kcs and readjust L10 and L11 for maximum output.

(*b*) At this time tune the signal generator from 110 to 115 kcs and observe the relative amplitude of the two peaks as indicated by the output meter. These peaks should be equal within 1 DB and the dip should be at 112.5 kcs. However these peaks may not be this symmetrical due to variations which may occur in the actual value of coupling in the first i-f.

(*c*) In the event the higher frequency peak is of greater amplitude, set the signal generator at a slightly higher frequency than 114.5 kcs and readjust inductors L10 and L11 for maximum output. If the higher frequency peak is of lesser amplitude, readjust L10 and L11 at a frequency slightly lower than 114.5 kcs. By one or more readjustments in this manner the peaks may be matched to the desired degree.

(*d*) It is to be noted that two i-f peaks will not generally occur at exactly 110.5 kcs and 114.5 kcs due to variations in coupling in the first i-f stage (mentioned above). The i-f transformers (T13 and T14) employ inductive coupling, with the first i-f slightly overcoupled to result in two peaks symmetrical with respect to the i-f of 112.5 kcs.

(*e*) Ground the grid of the heterodyne oscillator tube V7. Set the signal generator at 112.5 kcs and check the input to tube V6 required for a 50-milliwatt

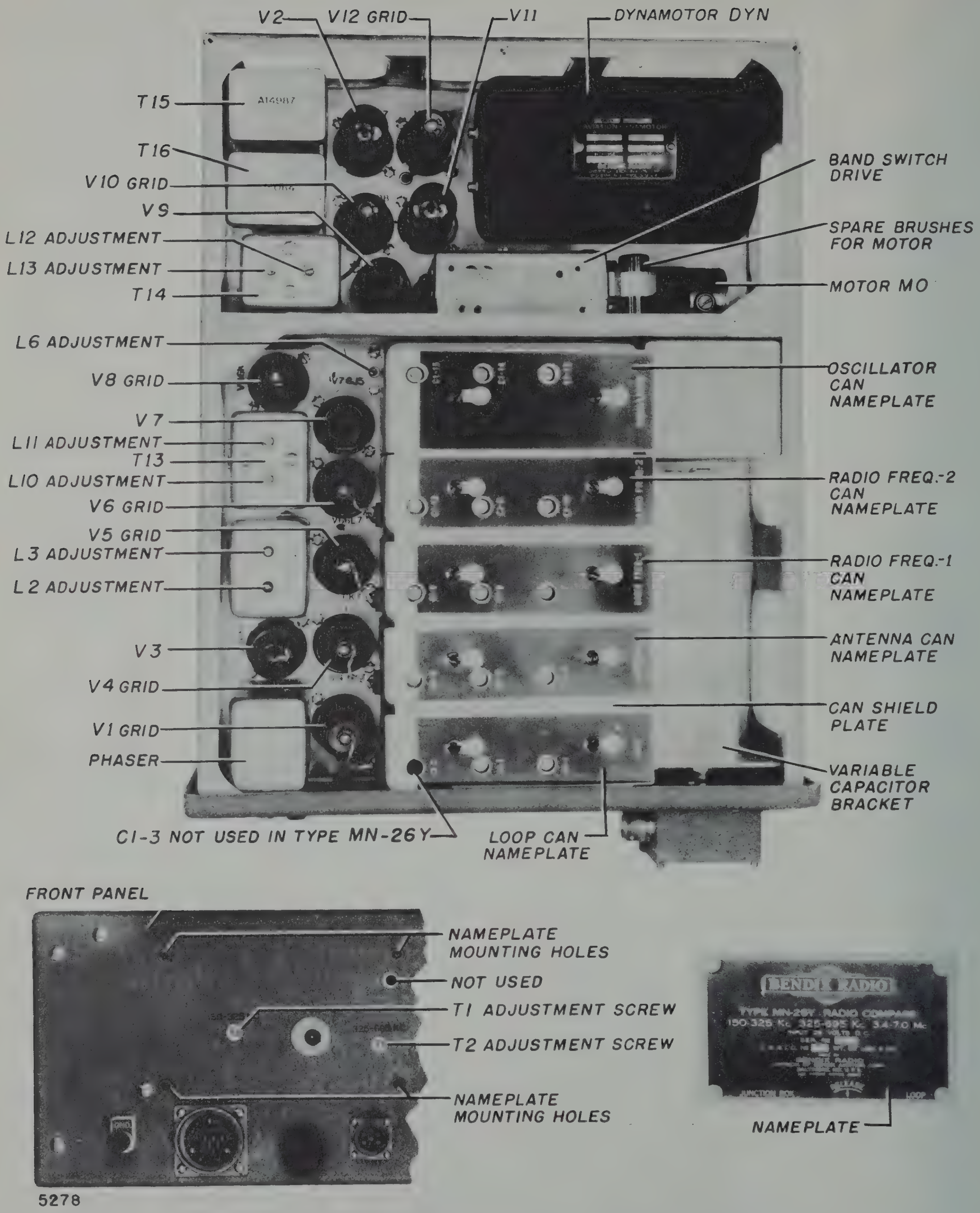


Figure 64 — Type MN-26 Radio Compass, Alignment Controls

output. This input should be approximately 500 to 900 microvolts. See section V, paragraph 28, c-w oscillator alignment.

b. RF OSCILLATOR ALIGNMENT (See figure 64).

(1) Operate radio compass unit on REC. ANT. switch position; AUDIO control at maximum clockwise position, plug headset into J1, and couple the signal generator to the control grid of the first detector tube V6.

(2) Turn on c-w oscillator, which has previously been adjusted to 112.5 kcs.

(3) Set the radio compass and the signal generator to 1500 kcs for Type MN-26A, MN-26C or MN-26CA, to 1750 kcs for Types MN-26W or MN-26X, or to 7.0 Mcs for Types MN-26Y and MN-26M. The signal generator output should be 1000 microvolts, unmodulated. Rotate trimmer C1-15 in the Oscillator can of the radio compass for zero beat in the headphones.

(4) Set the radio compass and the signal generator to 695 kcs for Types MN-26A, MN-26C or MN-26Y, or to 850 kcs for Types MN-26M, MN-26W or MN-26X. Rotate trimmer C1-14 for zero beat in the headphones.

(5) Set the radio compass and the signal generator to 325 kcs for Types MN-26A, MN-26C or MN-26Y, or to 410 kcs for Types MN-26M, MN-26W or MN-26X. Rotate trimmer C1-13 for zero beat in the headphones.

NOTE

If subsequent sensitivity measurements indicate poor tracking at low frequency ends of the bands, adjustment of the oscillator coil inductance on one or more bands will be necessary. The same equipment setup and procedure used at the high frequency ends of the bands is used for this alignment which is accomplished by adjusting the setting of the iron core screws (glyptalled factory adjustment) in T10, T11, or T12 (Bands I, II, and III oscillator transformers, respectively) as the case may be. If any alteration of the oscillator coil inductance is made, it is necessary to repeat the oscillator alignment procedure at the high frequency ends of the band or bands in question as outlined above. The low frequency end of the three bands is as follows:

Type Number	*Alignment Frequency*		
	Band I (kilocycles)	*Band II (kilocycles)*	*Band III (kilocycles)*
MN-26A	150	325	695
MN-26C	150	325	695
MN-26CA	150	325	695
MN-26M	200	410	3400
MN-26W	200	410	850
MN-26X	200	410	850
MN-26Y	150	325	3400

c. FIRST AND SECOND R-F AMPLIFIER AND ANTENNA STAGE ALIGNMENT (See figure 64).—Operate the compass unit on REC. ANT. switch position, AUDIO control at maximum clockwise position, plug an output meter into J1 and connect a signal generator to the antenna plug through a 100 mmf. dummy antenna except in the case of MN-26M, W and X, which are connected through a 50 mmf. dummy antenna. Set the signal generator for 30% modulation at 400 cycles.

(1) BAND III ALIGNMENT.—Set the radio compass and the signal generator at the highest indicated alignment frequency shown in the following table. Signal generator output should be adjusted to produce less than 50 milliwatts output as measured by the output meter. Adjust the trimmers listed in the following table for maximum output, reducing the input from the signal generator as much as is necessary to keep the output at approximately 50 milliwatts. Set signal generator output at 10 microvolts and reduce AUDIO control setting to a point at which slightly less than 50 milliwatts output is obtained and touch up the following trimmers for maximum output.

Compass Type	*Alignment Frequency*	*Band III Trimmers*		
		Antenna	*Radio Freq.-1*	*Radio Freq.-2*
MN-26A MN-26C MN-26CA	1500 kcs	C1-6	C1-9	C1-12
MN-26W MN-26X	1750 kcs	C1-6	C1-9	C1-12
MN-26M MN-26Y	7000 kcs	C1-6	C1-9	C1-12

(2) BAND II ALIGNMENT.—Repeat the procedure described in section V, paragraph 22*c* and 22*c*(1) above, except use the frequency and trimmers listed in the following table in place of those used for Band III alignment.

Compass Type	Alignment Frequency	Band II Trimmers		
		Antenna	Radio Freq.-1	Radio Freq.-2
MN-26A MN-26C MN-26CA MN-26Y	695 kcs	C1-11	C1-8	C1-5
MN-26X MN-26W	850 kcs	C1-11	C1-8	C1-5

(3) BAND I ALIGNMENT.—Repeat the procedure described in section V, paragraphs 22*c* and 22*c*(1), except use the frequency and trimmers listed in the following table in place of those used for Band III alignment.

Compass Type	Alignment Frequency	Band I Trimmers		
		Antenna	Radio Freq.-1	Radio Freq.-2
MN-26A MN-26C MN-26CA MN-26Y	325 kcs	C1-10	C1-7	C1-4
MN-26M MN-26W	410 kcs	C1-10	C1-7	C1-4

d. ADJUSTMENT OF I-F REJECTION TRAPS (See figure 64).—

(1) Connect a signal generator to the compass unit antenna plug through a 100 mmf. capacitor except in the case of Types M, W and X, when a 50 mmf. capacitor is used. Tune the compass and the signal generator to 150 kcs for Types MN-26A, MN-26C or MN-26Y, or 200 kcs for Types MN-26M, MN-26W or MN-26X. Signal generator output should be 4 microvolts, 30% modulated at 400 cycles. Adjust AUDIO control to a point at which 50 milliwatt output is obtained.

(2) Reset the signal generator to 114.5 kcs and adjust the signal generator output to 1 volt. Leaving the signal generator set at this frequency adjust the iron core of L3 until minimum output is obtained.

(3) Reset the signal generator to 110.5 kcs with 1 volt output and adjust the iron core of L2 for minimum output.

(4) With these adjustments made as described, there should be not more than 30 milliwatts of power output with 1 volt of input.

e. LOOP ALIGNMENT (see figure 64).

(1) Set the equipment as for a standard radio compass test setup. Turn the loop parallel to the transmission line and set the OFF-COM.-REC. ANT.-REC. LOOP switch to REC.LOOP position.

(2) Tune compass and set signal generator to the frequencies indicated in the following table (high end) for type of compass being used. Adjust the signal generator for an input to the loop of approximately 100 microvolts per meter, 30% modulated at 400 cycles. Adjust the LOOP can trimmers listed in the following table for a maximum indication on the output meter, adjusting the AUDIO control to maintain output meter readings below 50 milliwatts.

Compass Type	Band I		Band II		Band III	
	Alignment Frequency	Trimmer	Alignment Frequency	Trimmer	Alignment Frequency	Trimmer
MN-26A	325 kcs	C1-1	695 kcs	C1-2	1500 kcs	C1-3
MN-26C	325 kcs	C1-1	695 kcs	C1-2	1500 kcs	C1-3
MN-26CA	325 kcs	C1-1	695 kcs	C1-2	1500 kcs	C1-3
MN-26M	410 kcs	C1-1	850 kcs	C1-2	Not used	
MN-26W	410 kcs	C1-1	850 kcs	C1-2	1750 kcs	C1-3
MN-26X	410 kcs	C1-1	850 kcs	C1-2	1750 kcs	C1-3
MN-26Y	325 kcs	C1-1	695 kcs	C1-2	Not used	

(3) If loop sensitivity is unsatisfactory at the low frequency end of band or bands, it will be necessary to adjust the inductance of the loop coils, T1, T2, and T3. This may be accomplished by repeating the procedure outlined above, adjusting the iron cores, which have been glyptalled in place at the factory, for maximum indication on an output meter. These adjustments should be made at the low frequency ends of the band as listed in the following table. If it is necessary to change the settings of any of these iron core adjustments, it will be very important to readjust the trimmers C1-1, C1-2, and C1-3 as outlined above.

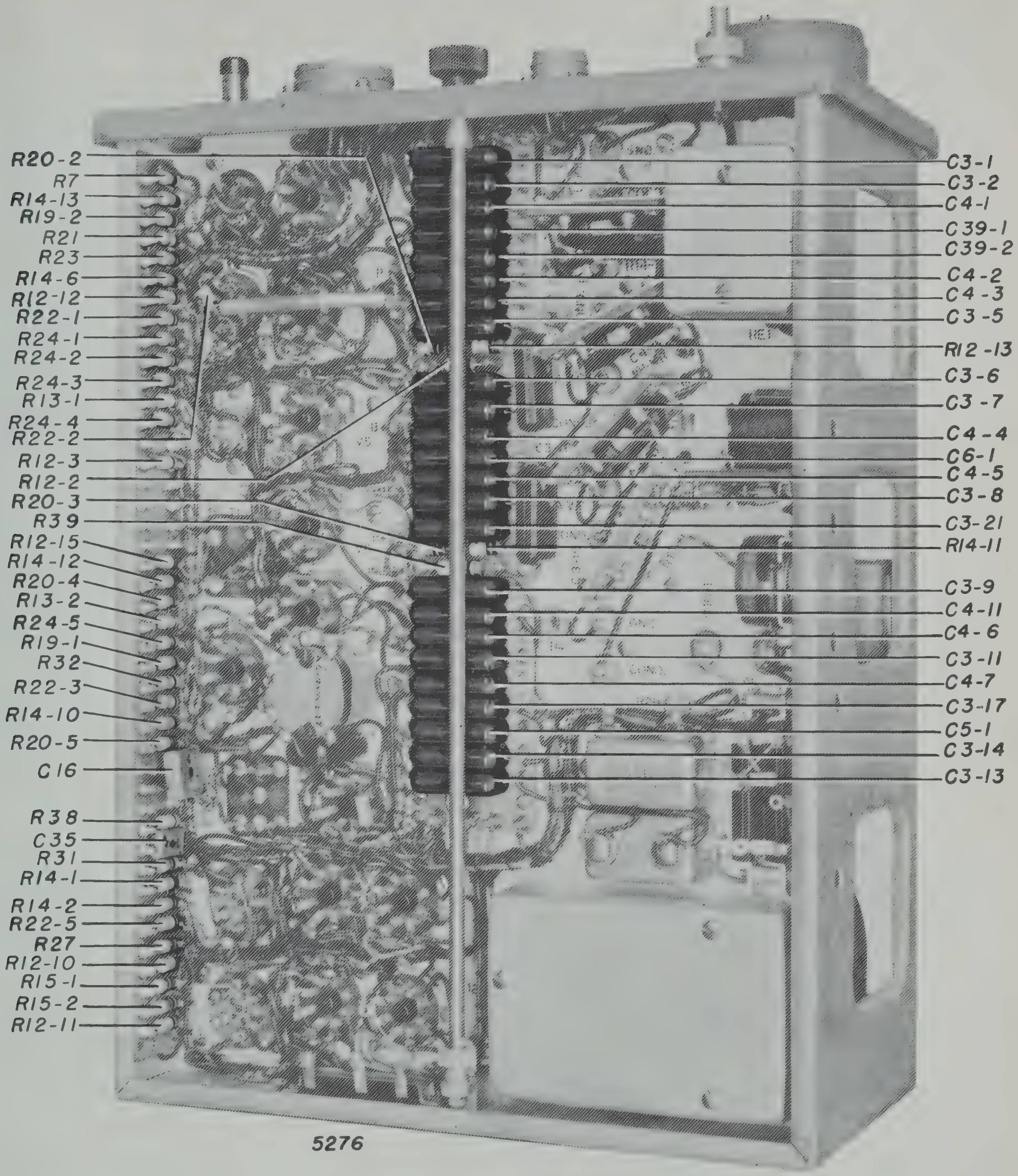


FIGURE 65 — TYPE MN-26 RADIO COMPASS, RIGHT BOTTOM VIEW OF CHASSIS

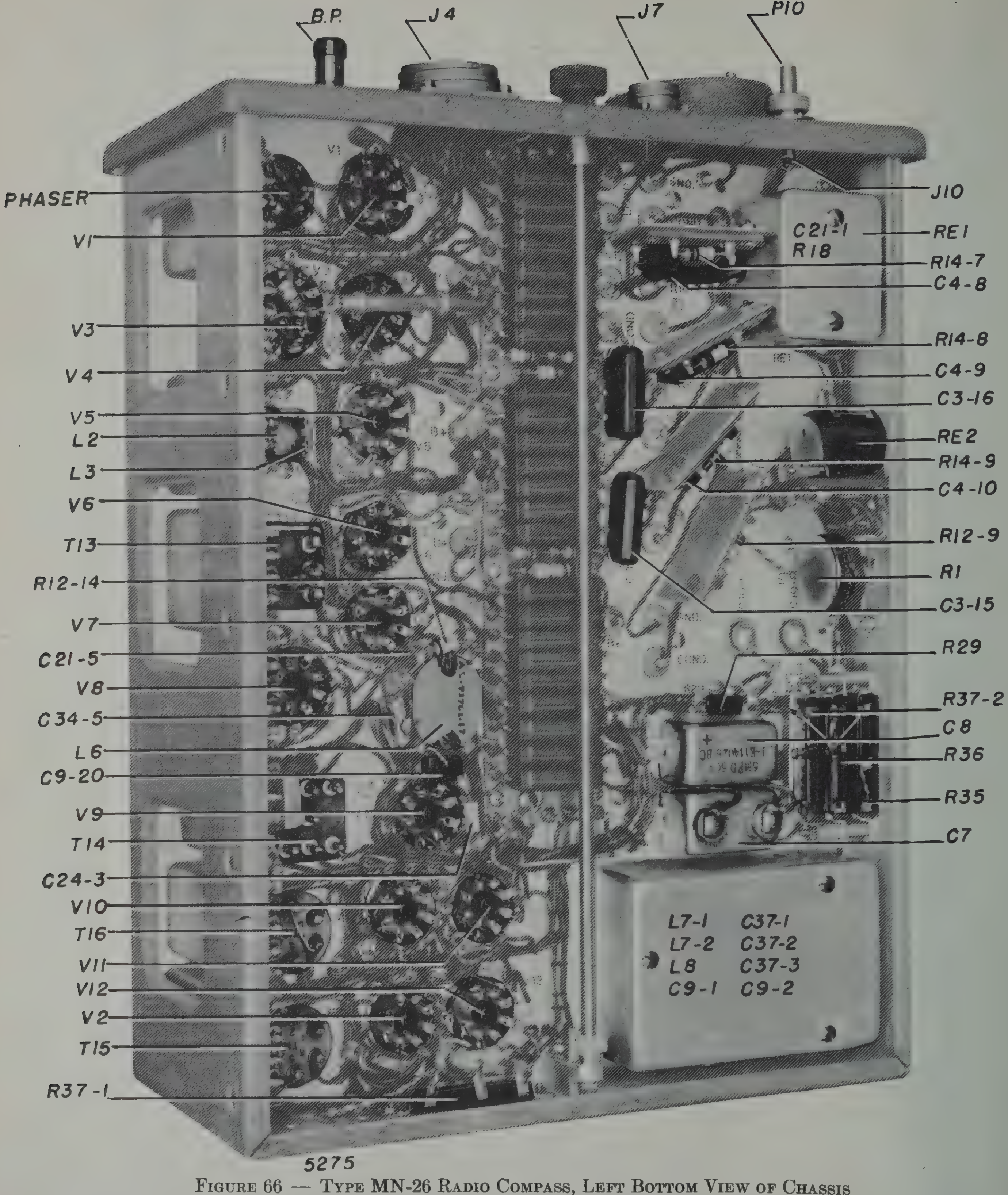


Figure 66 — Type MN-26 Radio Compass, Left Bottom View of Chassis

Compass Type	Band I		Band II		Band III	
	Alignment Frequency	Coil	Alignment Frequency	Coil	Alignment Frequency	Coil
MN-26A	150 kcs	T1	325 kcs	T2	695 kcs	T3
MN-26C	150 kcs	T1	325 kcs	T2	695 kcs	T3
MN-26CA	150 kcs	T1	325 kcs	T2	695 kcs	T3
MN-26M	200 kcs	T1	410 kcs	T2	Not used	
MN-26W	200 kcs	T1	410 kcs	T2	850 kcs	T3
MN-26X	200 kcs	T1	410 kcs	T2	850 kcs	T3
MN-26Y	150 kcs	T1	32 kcs	T2	Not used	

NOTE

The adjustment screws for the LOOP can inductances T1, T2, and T3 are made accessible by removal of the name plate on the front panel (see figure 64).

f. C-W OSCILLATOR ADJUSTMENT (see figure 64).

(1) Operate on REC. ANT., plub a headset into the TEL. jack J1. Set tuning dial to 695 kcs (or 850 kcs). Attach the lead from the signal generator to the grid of the first detector tube V6 through a 0.5 mfd capacitor, removing the regular grid clip at the top of the tube, and shunt this grid with a 500,000-ohm resistor.

(2) Apply a 113.5 kcs signal unmodulated. The signal generator output should be approximately 1500 microvolts.

(3) Adjust C-W oscillator coil L6 for zero beat in the headphones.

23. TROUBLE LOCATION AND REMEDY.

When one trouble has been found and remedied, check the equipment for proper operation. If unsatisfactory results are obtained, follow from the beginning the procedure outlined below to locate further sources of trouble. Before removing the equipment from the aircraft, ascertain that the fuse in the remote control is not burned out, that battery voltage is normal, that all cables are connected, and make sure that the nondirectional vertical antenna and lead-in are not grounded or open.

a. LOW COMPASS OUTPUT—ALL BANDS.

(1) TEST RECEIVER OUTPUT.—Operate the radio compass with the OFF-COMP.-REC. ANT.-REC. LOOP switch in REC. ANT. position. Tune to stations in each band and note whether trouble is experienced on only one or two bands. If so, proceed as outlined in section V, paragraph 23*b*. If the equipment operates satisfactorily as a receiver on all bands, check REC. LOOP operation of the equipment. If the equipment operates satisfactorily under both conditions, the trouble must be associated with the compass circuits. Proceed as outlined in the following paragraphs. If, however, the REC. LOOP operation of the equipment is unsatisfactory, proceed as outlined in section V, paragraph 23*d*. If trouble is encountered on all bands, proceed as outlined in section V, paragraph 23*c*.

(2) NORMAL RECEIVER OUTPUT (ANTENNA OR LOOP).—When normal REC. ANT. and REC. LOOP operation is obtained on all bands the trouble must lie in the compass circuits, and tests outlined in the following paragraphs should be made in sequence.

(3) AUDIO OSCILLATOR TEST.—With a vacuum tube voltmeter, measure AC voltage between ground and terminals 3 and 5 of the indicator. A .1 Mfd, 400-volt capacitor should be connected in series with the voltmeter. If the AF oscillator stage and the indicator are functioning properly, there will be an AC voltage of from 18 to 22 volts between ground and terminals 3 and 5.

(4) COMPASS OUTPUT AMPLIFIER TEST.—Test the tube V12 for emission and characteristics. Set the OFF-COMP.-REC.ANT.-REC.LOOP switch in COMP. position. Measure the socket voltages on the above tube and compare the readings obtained with the values given in the table in section V, paragraph 26. If considerable variation is noted from the typical values, check wiring and components of the circuits associated with the tube elements. Disconnect the compass indicator. Turn COMPASS control full on and apply a 1.5-volt, 48-cycle signal from an audio oscillator between ground and the junction capacitor of C7 and resistor R32. Connect an output meter between terminals 3 and 4 of compass output transformer can T16. If this stage is functioning properly, it should be possible to obtain an output of at least 5 milliwatts. If the transformer is defective, the entire transformer can assembly must be replaced. Check capacitor C7 for open or short circuit.

(5) LEFT-RIGHT INDICATOR TEST.—Check indicator and its associated cables for opens, shorts, and poor contacts. If the tests outlined above show no voltage across the indicator field with indicator connected, check the meter and its resonating condenser for shorts. When one indicator is being used, check the meter field load assembly for shorted or open conditions. If two left-right indicators are used, check one at a time by disconnecting the other and inserting the meter field load assembly supplied with the indicator in its place. If the moving coil of the indicator is intact, check between indicator terminal 4 and compass output transformer terminal 4 for open circuit. Proceed with tests outlined in section V, paragraph 28.

b. LOW REC.ANT. OUTPUT—1 or 2 BANDS.—If operation of the receiver is obtained on one or two bands, the necessity of checking operation of i-f, 2nd detector, audio, etc., circuits is unnecessary as it is obvious that these stages must be functioning to permit operation of at least one band. Proceed to the tests outlined in section V, paragraph 23.*c.*

c. LOW REC. ANT. OUTPUT—ALL BANDS.

(1) MISCELLANEOUS.—When both signal and noise output are low or absent, first check all external cable connections, including antenna connections, power supply connections, fuses, and headphone connections. Also, remove the cover of the antenna switching relay RE1 assembly and check operation of the relay, resistor R18-1, capacitor C21-1, and the relay contacts (see figure 68).

(2) REMOTE CONTROL UNIT.—Remove Type MN-28 Remote Control from its base and check wiring, components, and switch contacts for opens, shorts, and grounds. Continuity tests should be made back through the cable and junction box to the plug at the radio compass.

(3) POWER SUPPLY.—Failure of the primary power source may normally be detected by failure of the instrument lamps. The supply voltage (approximately 14 or 28 volts) should appear across the input leads under the hash filter cover (see figure 68). If no supply voltage appears at this point, check the continuity of the wiring and the contacts of switch S8 (see figures 69 and 70). If supply voltage is normal, approximately 200 volts should appear across the red and black leads under the hash filter cover (see figure 68). If this voltage is unreasonably low, check for short circuits in wiring or components associated with or connected to the high voltage supply. Lack of dynamotor output voltage, if the primary supply is normal, indicates a defective dynamotor.

(4) TUBES.—Test all tubes for emission and other characteristics. Any tubes not having characteristics within standard limits should be replaced.

(5) VOLTAGE MEASUREMENTS.—Socket voltages should be measured with the OFF-COM.-REC.ANT.-REC.LOOP switch in REC. ANT. position and compared to the values given in the table in section V, paragraph 26. If any considerable variation from typical values is noted, check all resistors, capacitors, and wiring in circuits associated with the tube elements.

(6) AUDIO OUTPUT AMPLIFIER TEST.—Plug a headset into the TEL. jack on Type MN-28Y Remote Control and while listening, touch the grid cap of the second detector tube V10 (see figure 68). A loud click or whistle should be heard. If no sound is heard, measure the socket voltages of the audio output tube V11, and the second detector tube V10, and compare readings obtained with the values given in the table in section V, paragraph 26. If any considerable variation from the typical values is noted, check wiring and components in the circuits associated with the tube elements. Apply a 400-cycle signal from an audio oscillator to the grid of the audio output tube V11 (socket terminal 5, see figure 72); plug an output meter into TEL. jack J1 and measure the audio oscillator voltage required for an output of 50 milliwatts. If the stage is functioning properly, it will be possible to obtain this output with an audio oscillator voltage of less than 1.5 volts. Likewise, an audio oscillator voltage of approximately .025 volts applied to the grid of the second detector tube V10 (see figure 68), should give an output of 50 milliwatts. If the output is low when feeding the audio oscillator into the grid of the second detector V10, but normal when feeding into the grid of the audio output tube V11, connect the audio oscillator through a 1. Mfd capacitor to the plate of the second detector tube V10 (socket terminal 3). If satisfactory output is obtained when the audio oscillator is connected to the grid of the audio output tube V11, but not when connected to the plate of the second detector tube V10, capacitor C16 or the relay RE2 contacts are defective.

(7) AVC CIRCUIT TESTS.—Extreme insensitivity of the radio compass unit may be caused by failure of C4-8, C4-9, or C4-10. One of these capacitors opening up removes the RF ground from the grid return of the associated stage. If the AVC is inoperative, check C6-1 for short circuit. A defective tube in the second detector stage may also cause ineffective AVC operation.

(8) I-F AMPLIFIER TESTS.—Apply a 112.5 kcs signal, 30% modulated at 400 cycles, to the grid of the i-f tube V8 and plug an output meter into the TEL. jack. Measure the signal generator voltage required to produce an output of 50 milliwatts. If this stage is functioning properly, a signal generator input of less

than 50,000 microvolts will be required. If more than 50,000 microvolts is necessary, adjust L12 and L13 to determine whether or not the sensitivity is due to misalignment of T14. If satisfactory alignment cannot be obtained, remove T14 and check all wiring and components. If function of this stage is normal, ground the grid of the RF oscillator tube V7, and apply a 112.5 kcs signal, 30% modulated at 400 cycles from the signal generator to the grid of the first detector tube V6 through a 0.5 mfd capacitor, removing the regular grid clip, and shunt the grid of the first detector tube V10 with a 500,000-ohm resistor. If this stage is functioning properly, an input of less than 900 microvolts will be necessary to produce an output of 50 milliwatts. If an input of more than 900 microvolts is necessary, carefully check alignment of T13, alignment procedure for which will be found in section V, paragraph 22*a*. If satisfactory alignment and sensitivity of this stage cannot be obtained, remove T13 and check all wiring and components.

(9) R-F SYSTEM TESTS.—Set the band switch on one of the bands on which trouble is encountered and set the tuning dial to the alignment frequency for that band as given in section V, paragraph 22*e*. Beginning at the grid of the first detector tube V6, apply a 30% modulated (400 cycles) signal from the signal generator.

900 microvolts input to this stage from the signal generator should give approximately 50 milliwatts output from the audio output amplifier. As the signal is fed successively into the grids of the second r-f, first r-f stages, etc., considerably less input from the signal generator should result in the same 50 milliwatts output. If a stage is reached where the signal necessary to produce 50 milliwatts output is greater than or only slightly less than it was for the preceding stage, that stage is faulty and tests outlined in the next two paragraphs should be applied, as the case might be.

(10) R-F OSCILLATOR TESTS.—If socket voltage measurements on the first detector tube V6 fail to reveal the source of trouble, set the band switch to one of the inoperative bands and rotate the tuning dial to the alignment frequency for that band, as given in section V paragraph 22 and apply a signal generator voltage of that frequency, 30% modulated at 400 cycles to the grid of the first detector tube V6 as described in section V, paragraph 23*c*(8) above. Turn AUDIO control fully clockwise. It should be possible to obtain an output of 50 milliwatts at the TEL. jack for an input of less than 900 microvolts from signal generator. If these conditions can be met, the trouble is in one of the r-f stages and the procedure outlined in the next paragraph should be followed. If the conditions cannot be met, check the alignment of the r-f oscillator, following the procedure given in section V, paragraph 22*b*. If satisfactory alignment is not obtainable, remove the r-f OSCILLATOR assembly (see figure 64), and check all wiring, contacts of switch S4, capacitors, resistors, and inductors.

(11) R-F AMPLIFIER TESTS.—If socket voltage measurements on the first and second r-f tubes fail to reveal the source of trouble, set band switch to one of the inoperative bands and rotate tuning dial to alignment frequency for that band, as given in section V, paragraph 22, and apply a signal generator voltage of that frequency, 30% modulated at 400 cycles, to the grid cap of the second r-f tube V5. It should be possible to obtain an output at the TEL. jack of 50 milliwatts for an input of less than 120 microvolts from the signal generator. If these conditions cannot be met, check the alignment of the second r-f circuit, following procedure given in section V, paragraph 22*b*. If satisfactory alignment is not obtainable, remove the RADIO FREQ.-2 assembly, (see figure 64) and check wiring, switch contacts, capacitors, and resistors. If satisfactory output is obtainable from the second r-f stage, the procedure outlined above should be repeated for the first r-f stage. It should be possible to obtain an output of 50 milliwatts with an imput of 20 microvolts to the grid of the first r-f tube V4. If the first r-f stage is functioning properly, apply a 5-microvolt signal (up to 1750 kcs—8 microvolts above 1750 kcs.) to the antenna pin on the panel of the compass unit, and if 50 milliwatts or more output, with no more than 12.05 MW noise, is not obtainable, check antenna relay contacts, resistor R18-1, capacitor C21-1 (or capacitor C43-1) and operation of the relay RE1. If normal operation is still unobtainable, remove the ANTENNA can assembly, and check wiring, switch contacts, capacitors and antenna coils located in T4, T5, and T6.

d. LOW REC. LOOP OUTPUT.—Operate the radio compass with the OFF-COMP.-REC. ANT.-REC. LOOP switch in REC. LOOP position. Tune to stations in each band, observing whether trouble is encountered on all bands or only on one or two bands. If equipment is inoperative on all bands, proceed as outlined in section V paragraph 23*d* (1). If however, trouble is encountered on only one or two bands, remove the compass unit from the cabinet and set up on the test bench. Measure voltage on the plates of modulator tube V3 for each setting of the band switch. If any considerable variation is noted from values given in section V, paragraph 28, remove the ANTENNA can assembly, and check contacts of S1-2 and plate winding of T4, T5, and T6 for open or short circuits. If the nature of the trouble encountered on only one or two bands is not apparent from the foregoing tests,

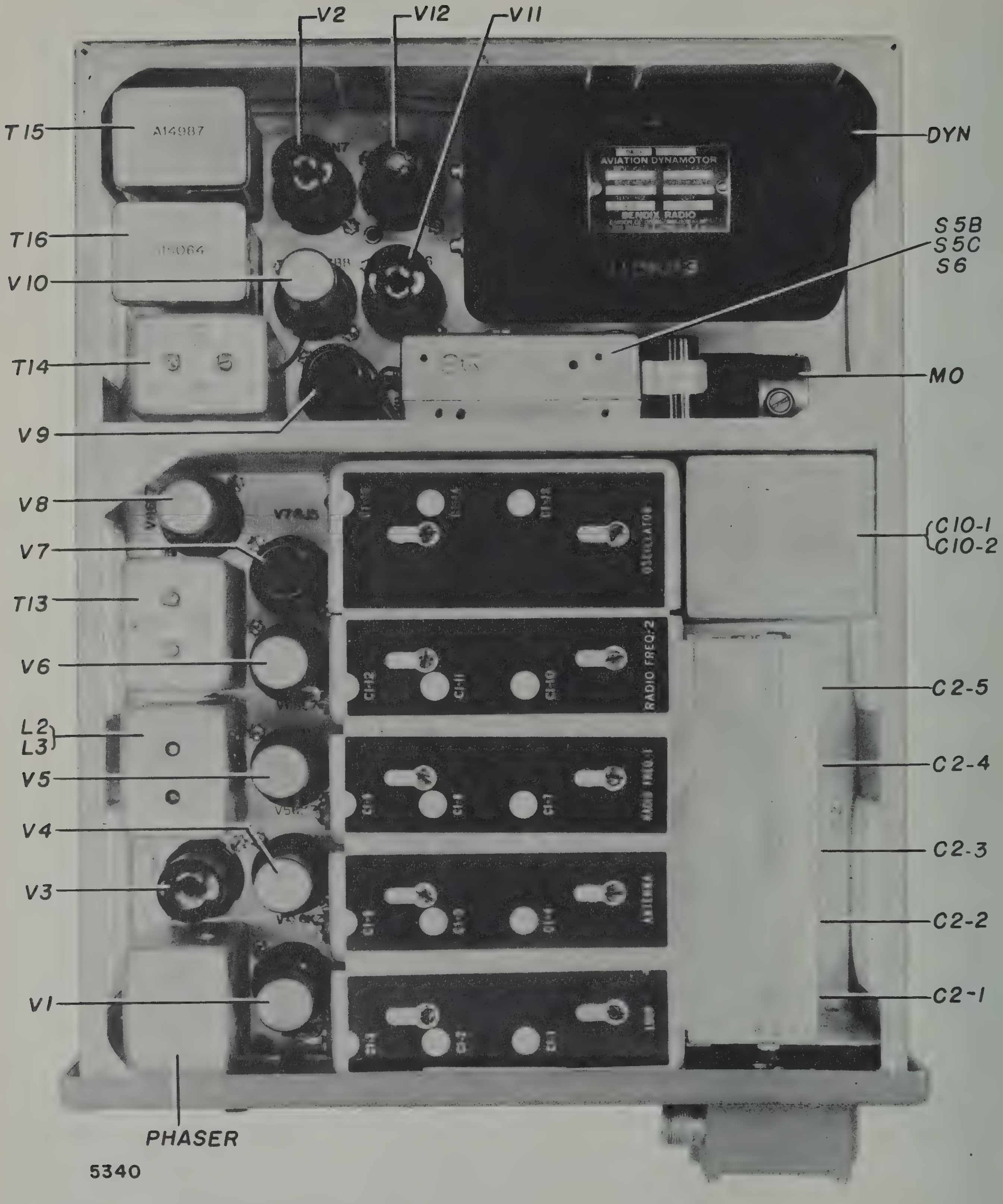


FIGURE 67 — TYPE MN-26 RADIO COMPASS, TOP OF CHASSIS

proceed as outlined in section V, paragraph 23*d* (2) below.

(1) MODULATOR TEST.—Measure socket voltages of the modulator tube V3 and compare with values given in the voltage table. If any considerable variation from typical values is noted, check wiring and components of the circuits associated with the tube elements. With the OFF-COMP.-REC. ANT.-REC. LOOP switch in COMP. position and the compass unit tuned to the aligning frequency (as given in section V, paragraph 22), on any one of the faulty bands, set the loop gain R1, COMPASS R3, and threshold sensitivity R2, controls at maximum and ground grid 1 (socket terminal 4) of the modulator tube V3. Apply a 7-microvolt signal generator voltage of the aligning frequency to grid 2 (socket terminal 5) of the modulator tube V3 and observe the left-right compass indicator. If the modulator stage is functioning properly the indicator pointer will deflect full scale to right. Repeat test, grounding grid 2 and applying signal to grid 1. The indicator pointer should deflect full scale to left.

(2) LOOP AMPLIFIER TEST.—Measure the socket voltages of tube V1 and compare readings obtained with values given in the voltage table. If any considerable variations from typical values are noted, check wiring and components of circuits associated with the tube elements. If all bands are inoperative, remove the phaser can assembly (see figure 66) and check all wiring and components for open or short circuits. If only one or two bands are inoperative, roughly check alignment of loop stage trimmers of the bands at fault. If proper alignment appears impossible, remove the LOOP can assembly and check all components, switch contacts, and wiring.

(3) LOOP TEST.—Test loop, mounting (brushes and rings on rotatable mounting), and loop cable for open or short circuits or grounds. Also check for poor contact at plugs.

(4) LOOP STAGE ALIGNMENT.—If it has been necessary to make any alteration in the settings of the loop stage trimmers, it will be necessary to realign this stage completely. The procedure outlined in section V, pragraph 22*e* should be followed.

e. NOISY COMPASS OR RECEIVER OPERATION.—To locate the cause of noisy operation, check the following components:

Check	*For*
Vacuum tubes	Microphonic or defective tubes.
Dynamotor	Worn or arcing brushes.
Loop	Dirty or flattened pins.
Loop mounting	Corroded sockets, dirty brushes or rings.
Cable plugs	Poor contacts.

Check	*For*
Bonding	Loose connections. Chassis not grounded.
Switches	Dirty contacts.
Variable capacitors	Dirt between plates.
Power source	Loose or corroded connections.
Circuits	Loose wires, defective capacitors or resistors.

24. LUBRICATION.

The following parts require lubrication after the hours of service indicated below:

Part	*Time*	*Lubrication*
Dynamotor	1000 hours	Beacon M-285
Loop mounting gears and bearings	1000 hours	Beacon M-285
Radio compass and remote control tuning gears and bearings	1000 hours	Beacon M-285
Mechanical tuning shafts	As required	Beacon M-285

Do not lubricate the variable tuning capacitor, potentiometers or dynamotor commutator. Band switch motor MO is permanently lubricated and will not require attention, unless it is disassembled, in which case the bearings should be repacked with Beacon M-285 low temperature grease. If the dial gear mechanism is disassembled, the ball bearings should be repacked with Beacon M-285 low temperature grease.

25. DISASSEMBLY OF UNITS.

a. REMOVAL OF RADIO COMPASS FROM MOUNTING BASE.—Turn the three Dzus fasteners, lift the front of the cabinet and pull forward.

b. REMOVAL OF RADIO COMPASS CHASSIS FROM CABINET.—Turn the RELEASE knob on the front panel to the left until the chassis will slide out of the cabinet by pulling the panel forward. Pull the chassis from the cabinet. The chassis may be placed on any one of five sides (but not on front panel) without injury to its components.

c. REMOVAL OF HASH FILTER COVER.—Remove the three mounting screws which secure the hash filter cover (see *a*, *b*, and *c*, of figure 68).

d. REMOVAL OF DYNAMOTOR.—Remove the three mounting screws (see *a*, *b*, and *c*, of figure 68) and remove hash filter cover. Remove the red, yellow and black wires from terminals R, Y, and B of hash filter terminal board TB4. Cut the dynamotor tie wire and remove the dynamotor mounting screws (*d* and *e* of figure 68). Do not allow the dynamotor to drop.

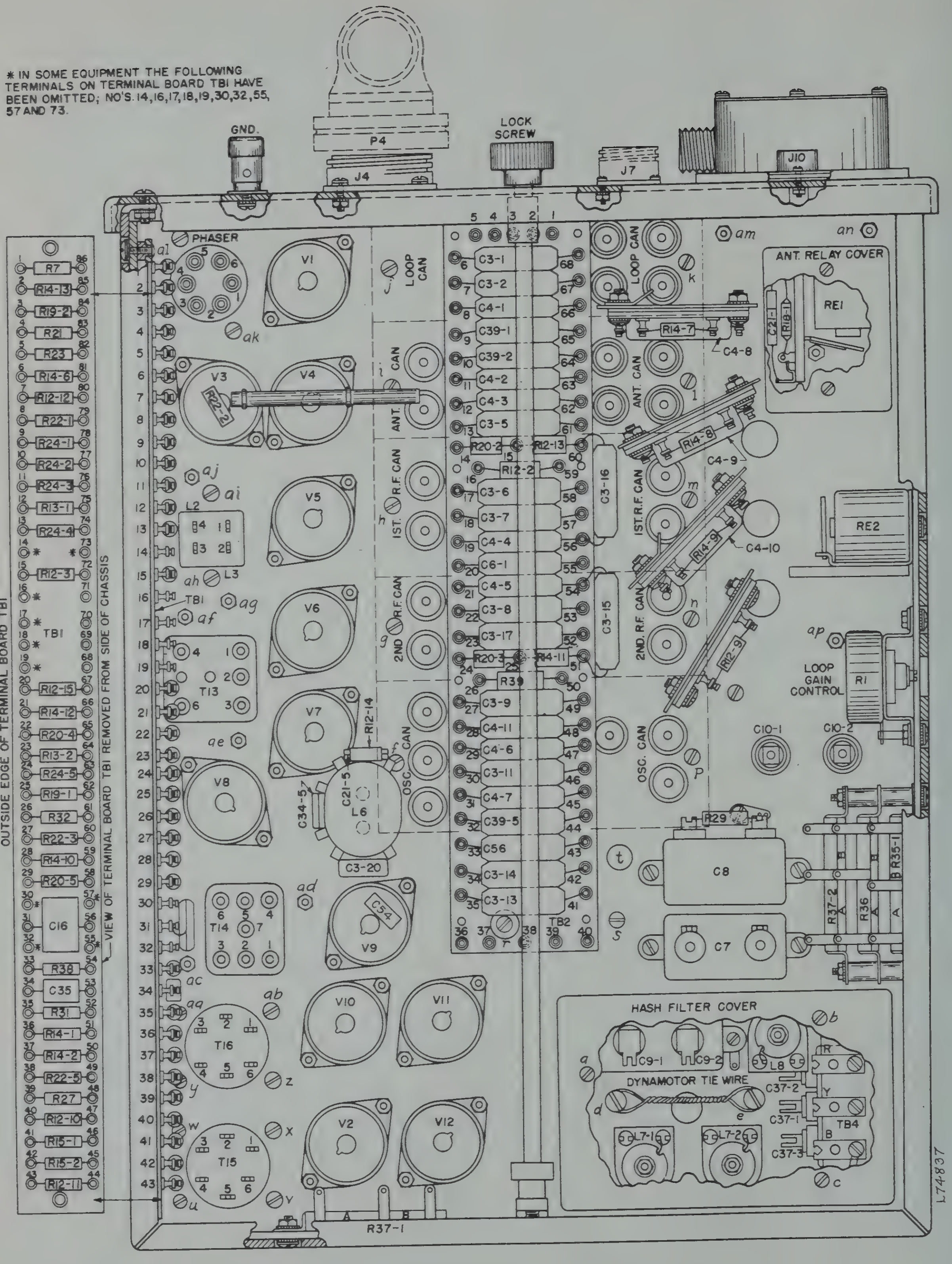


Figure 68 — Type MN-26 Radio Compass, Chassis Layout

e. DYNAMOTOR DISASSEMBLY.

(1) Remove the screws, and slide off the dust covers.

(2) Unscrew the brush-holder caps, and remove the brushes.

(3) Disconnect the leads from the brush holders on each end of the dynamotor. Unscrew the frame bolts, and remove the end brackets. Slide out the armature.

(4) Unscrew the field-retaining screws and remove the fields. Be careful not to damage the wiring or insulation.

(5) In reassembling the dynamotor, make certain that the armature is replaced in proper position. The commutator with the wide segments should be at the low-voltage end-bracket. Clean out carefully and dust any other foreign matter which might interfere with the armature clearance. Replace the brushes in their proper location with the "+" or "−" markings on the brush facing the corresponding markings on the end bracket. Apply glyptal cement to the frame bolts and field-retaining screws. Replace safety wires.

f. DISASSEMBLY OF BAND SWITCHING COMPONENTS.

(1) REMOVAL OF BAND SWITCH DRIVE SHAFT.—Remove the four screws which secure the nameplate to the front panel, and remove the nameplate. Withdraw the band switch drive shaft by pulling out with a long nose pliers.

(2) REMOVAL OF OSCILLATOR, RADIO FREQ.-2 RADIO FREQ.-1, ANTENNA AND LOOP CANS.—Remove the band switch drive shaft [section V, paragraph 25*f*(1)]. Remove the screws which secure the can nameplates to the cans and remove the can name plate. Lift off the can shield-plate. Remove the three screws which secure the variable-capacitor-bracket and remove bracket. Remove the grid cap from the tube which is associated with the can that is to be removed. Figure 68 points out the various elements described above. Turn the compass over to expose the side shown in figure 68. Unsolder the leads from the terminals of the cans and remove the screws which secure the cans to the chassis (see figure 68). The terminals and screws are as follows:

(*a*) OSC. CAN.—The screws which secure the OSCILLATOR can are *f*, and *p* of figure 68. The terminals are as follows:

Chassis Stenciling	*Wire Color*	*Wire Connects To*
G	Green	V7 term. 5
P	Blue	V7 term. 3
INJ.G	Green	V6 term. 5
B+	Red	TB2 term. 51
GND.	Black-Green	C2-5 rotor (gnd.)
COND.	Green	C2-5 stator

(*b*) 2ND R. F. CAN.—The screws which secure the RADIO FREQ.-2 can are *g*, and *n* of figure 68. The terminals are as follows:

Chassis Stenciling	*Wire Color*	*Wire Connects To*
B+	Red-Green	TB2 term. 24
P	Blue	V5 term. 3
AVC	Black-Green	Junct. C4-10 & R14-9
COND.	Green	C2-4 stator

(*c*) 1ST R. F. CAN.—The screws which secure the RADIO FREQ.-1 can are *h*, and *m* of figure 68. The terminals are as follows:

Chassis Stenciling	*Wire Color*	*Wire Connects To*
B+	Red-Green	TB2 term. 17
P	Blue	V4 term. 3
AVC	Black-Green	Junct. C4-9 & R14-8
COND.	Green	C2-3 stator

(*d*) ANT. CAN.—The screws which secure the ANTENNA can are *i* and *l* of figure 68. The terminals are as follows;

Chassis Stenciling	*Wire Color*	*Wire Connects to*
P (nearest panel)	White-Orange	V3 term. 3
P	White-Black	V3 term. 6
ANT.	White-Green (Black spaghetti covered)	RE1
AVC	Black-Green	Junct. C4-8 & R14-7
COND. (nearest terminal board)	Red-White	TB2 term. 60
COND.	Green	C2-2 stator

(*e*) LOOP CAN.—The screws which secure the LOOP can are *j* and *k* of figure 57. The terminals are as follows:

Chassis Stenciling	*Wire Color*	*Wire Connects To*
LOOP (nearest front panel	Green	J7 term. 5
LOOP	Green-White	J7 term. 1
GND.	Black	J7 term. 3
COND.	Green	C2-1 stator

(3) REMOVAL OF BAND SWITCH DRIVE ASSEMBLY.

(*a*) Unsolder the following wires from terminal board TB2 and ground lug of the tube socket for V9 (wires protrude from hole *t* of figure 68).

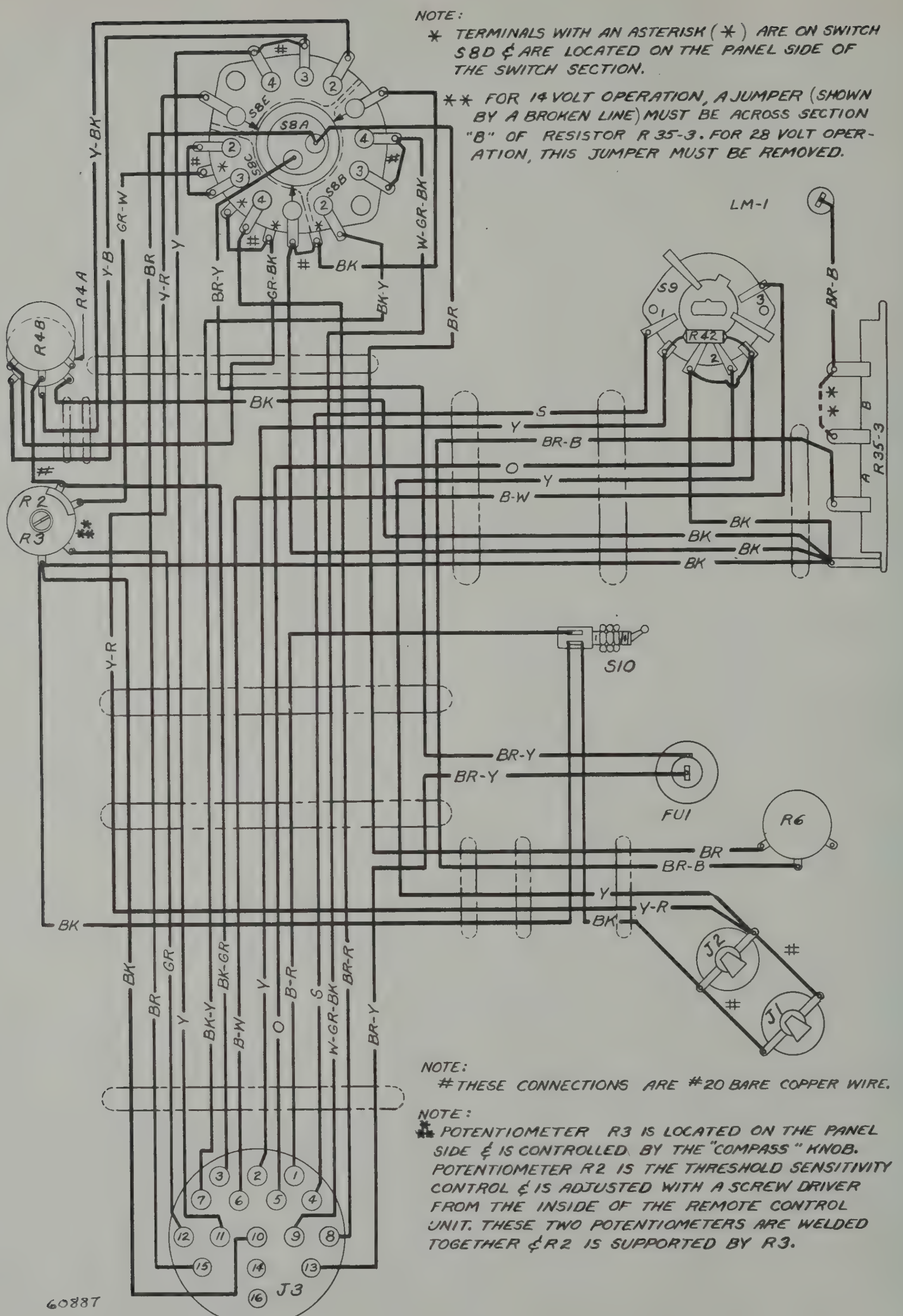


Figure 69 — Types MN-28C, MN-28NA, and MN-28Y Remote Controls, Wiring Diagram

Wire Color	*Connection*
Slate	TB2 term. 40
Orange	TB2 term. 39
Blue-White	TB2 term. 38
Brown	TB2 term. 37
Yellow	TB2 term. 36
Black	V9 ground lug

Remove the band switch drive shaft [see section V, paragraph 25*f*(1)]. Remove the two band switch drive mounting screws (*r* & *s* figure 68). Lift out band switch drive assembly.

(*b*) When reassembling, make sure that the arm of each wafer switch is in the same relative position before attempting to reinsert the band switch drive shaft. This may be ascertained by sighting through the shaft hole and noting the location of the positioning cut-out in each switch arm. Do not force the band switch drive shaft since this may damage the switch wafers. After the band switch drive shaft is engaged with *all* of the switch wafers, rotate it *with the fingers* to make certain that it is operating freely.

(4) DISASSEMBLY OF BAND SWITCH DRIVE ASSEMBLY.—After removal [see section V, paragraph 25*f*(3)], the band switch drive may be disassembled by removing the three screws which hold the two halves of the housing together. When reassembling, apply glyptal cement to the screws.

(5) DISASSEMBLY OF BAND SWITCH MOTOR.—The band switch motor is secured to the band switch drive assembly by four screws.

(*a*) Unsolder the red, blue, and brown motor wires from the wafer switch S5.

(*b*) Loosen the set screws and remove the worm from the motor shaft.

(*c*) Loosen the brush-retaining screws in the side of the motor and withdraw the brushes.

(*d*) Remove the two screws from the brush bell (name plate end of motor). Tap the rim of the front end-bell *lightly* with a wooden mallet or block until it separates enough from the housing to permit inserting a screw driver blade. Pry the end-bell off the housing, being careful not to damage either.

(*e*) The armature will probably be removed with the end-bell, and if so, can be separated from it by tapping lightly on the motor shaft with a wooden mallet or block.

(*f*) The rear end-bell is removed from the housing in the same way as the front end-bell.

(*g*) In reassembling the motor, the brush holders should first be mounted in the rear end-bell (if they had been removed) and the end-bell pressed onto the housing. Make sure that the notch in the rim of the end-bell engages the positioning stud in the housing. Next, set the armature in place and tap lightly to seat the rear bearing. Apply glyptal cement to all screws. Press the front end-bell in place, with the notch in the rim in line with the positioning stud and draw up tightly by means of the two frame screws. Reassemble the brushes, making certain that the brush marked "+" is mounted in the brush holder marked "+", and that both brushes are mounted with the markings on the brush facing the markings on the end-bell. Replace the brush retaining screws, being careful not to twist the brush wires. Replace the worm on the motor shaft. Resolder the wires to the proper terminal of the wafer switch S5. Secure the motor to the drive assembly.

g. REMOVAL OF OUTPUT TRANSFORMERS T15 and T16.—Unsolder the leads from the terminals and remove the screws which secure them to the chassis. These assemblies are potted and must not be opened. The screws are shown in figure 68 as *u*, *v*, *w*, and *x* for audio output transformer T15, and as *y*, *z*, *aa* and *ab* for compass output transformer T16. The leads are as follows:

(1) AUDIO OUTPUT TRANSFORMER T15.

Transformer Terminal No.	*Wire Color*	*Wire Connects To*
1	Blue	V11 term. 3
2	Orange-Red	V11 term. 4
3	Yellow*	TB2 term. 36*
4	No connection*	
5	Red-Green	T16 term. 5
	Red-Green	L8 (in hash filter)
6	Black	V2 ground lug

* For low impedance (600Ω) output. If receiver is wired for high impedance (4000Ω) output, the yellow wire connects to terminal 4 and no connection is made to terminal 3.

(2) COMPASS OUTPUT TRANSFORMER T16.

Transformer Terminal No.	*Wire Color*	*Wire Connects To*
1	Blue-Red	V12 term. 3
2	Red	TB1 term. 58
	Red**	T16 term. 6**
3	Black	V10 ground lug
4	Yellow-Green	J4 term. 21
5	Red-Green	J4 term. 10
	Red-Green	T15 term. 5
6	Red	C10-2

** Jumper between terminals 2 and 6 of compass output transformer T16.

h. REMOVAL OF I-F TRAP L2, L3.—Unscrew the nuts on the spade lugs and remove shield can (*ag*, and *aj* of figure 68). Unsolder the leads from the terminals

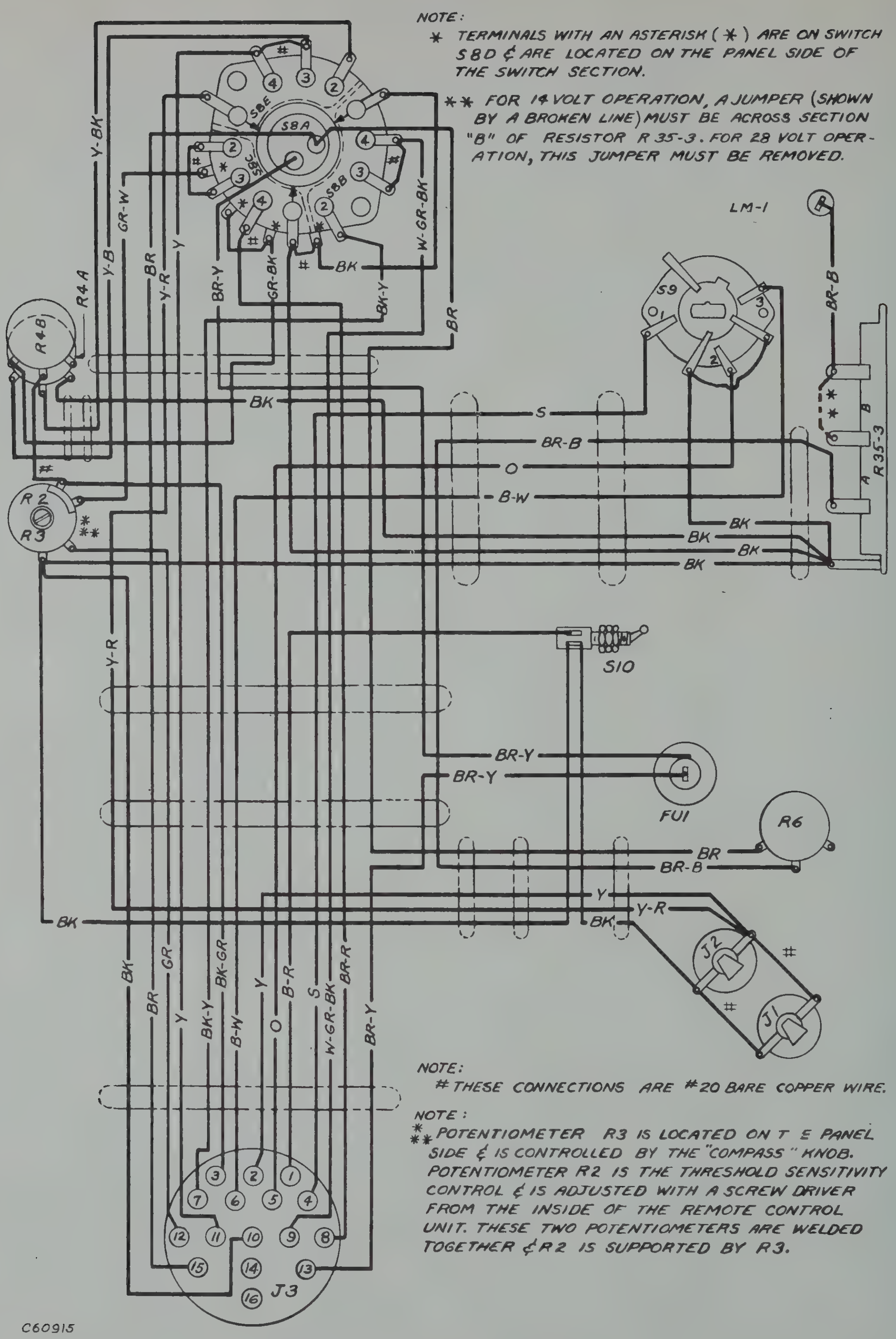


Figure 70 — Types MN-28G and MN-28X Remote Controls, Wiring Diagram

and remove the two screws holding the assembly to the chassis (*ah* and *ai* of figure 68). The following table lists the connection to the i-f trap L2, L3:

Trap Terminal No.	*Wire Color*	*Wire Connects To*
1	Black-Orange	V5 term. 8
2	Black-White	TB2 term. 19
	Black-White	TB1 term. 10
3	Black-Red	TB2 term. 12
	Black-Red	TB1 term. 9
4	Black-Green	V4 term 8

In reassembling, do not tighten the screws holding the assembly until the shield can has been mounted and the nuts on the spade lug brought up tight.

i. REMOVAL OF TRANSFORMERS T13 and T14.—Unsolder the leads from the terminals and remove the nuts which secure them to the chassis. The nuts are shown in figure 68 as *ac*, and *ad* for the second i-f transformer T14 and *ae*, and *af* for the first i-f transformer T13. The leads are as follows:

(1) 1st I-F TRANSFORMER T13.

Transformer Terminal No.	*Wire Color*	*Wire Connects To*
1	Blue	V6 term. 3
2	White-Green-Black	T14 term. 6
3	Black	V7 ground lug
4	Red-Green	TB1 term. 22
6	Black*	T13 term. 3*

* Jumper between terminals 3 and 6 of transformer T13.

(2) 2ND I-F TRANSFORMER T14.

Transformer Terminal No.	*Wire Color*	*Wire Connects To*
1	Blue-White	V10 term. 5
2	Blue-Orange	V10 term. 4
3	Red-Green	TB1 term. 29
4	Blue	V8 term. 3
5	Black-Red	V10 term. 8
6	White-Green-Black	T13 term. 2
	White-Green-Black	R14-9
7	Black	V8 ground lug

j. REMOVAL OF PHASER.—Unsolder leads from terminals and remove screws which secure the phaser to the chassis (*ak*, and *al* of figure 68). The leads are as follows:

Phaser Terminal No.	*Wire Color*	*Wire Connects To*
1	Red-White	TB2 term. 6
	Red-White	TB1 term. 3
2	Green	V3 term. 5
3	Green-White	TB2 term. 10
	Green-White	TB1 term. 47
4	Green-Black	TB2 term. 9
	Green-Black	TB1 term. 44
5	Green	V3 term. 4
6	Blue	V1 term. 3

k. REMOVAL OF BFO COIL ASSEMBLY L6.—Unsolder the lead from terminals and remove the two screws which secure the beat-frequency-oscillator coil assembly to the chassis. The screws are located on the top of the chassis near the OSCILLATOR can and the stencil "V7 6J5". The center screw is the iron core adjustment screw and *should not be turned.* The leads are as follows:

L6 Terminal No.	*Wire Color*	*Wire Connects To*
1	Green	V9 term. 5
2	C3-20*	Through C3-20 to V9 ground lug*
	Blue-Red	TV1 term. 66
3	Black-Red	V9 term. 8

* One lead of capacitor C3-20 connects to L6, terminal 2 and the other connects to the ground lug of V9.

When this coil assembly is removed the following jumper, resistor, and capacitors are connected to the terminal lugs:

(1) Capacitor C34-5 connected between terminals 2 and 4.

(2) Jumper connected between terminals 4 and 5.

(3) Capacitor C21-5 and resistor R12-14 connected between terminals 5 and 6.

(4) Jumper connected between terminals 1 and 6.

l. REMOVAL OF VARIABLE CAPACITOR ASSEMBLY.—Unsolder the leads, remove the gear box assembly and remove the three nuts which secure the variable capacitor assembly to the chassis. The nuts are shown in figure 68 as *am*, *an*, and *ap*.

m. TYPE MN-22A AZIMUTH INDICATOR DISASSEMBLY AND MAINTENANCE (See figure 37).—Disassembly of certain parts may be accomplished as follows:

(1) Remove the dial rotating knob from its shaft by loosening the two Bristo set screws.

(2) To remove the pointer shaft drive gear, uncouple the spring and loosen the two Bristo set screws. This will permit disassembly of the pointer assembly and the worm gear to which the cross slide assembly is attached. Before the screws ,are loosened, set the

pointer on zero and carefully scribe a line on the pointer shaft drive gear and on the cross slide, so that these three parts can be reassembled without changing their relative positions; otherwise, a shift in the error correction will occur. To check for proper assembly, set the cam follower pin at the zero degree (0°) radial line on the cam blank; the pointer should read zero (0°) degrees on the dial when the distance between the center of the shaft and the inside edge of the cam follower pin measures 1.062 inch. In making this check with an unfiled cam, the pointer should read 20° when the cam follower pin is set at the 0° radial line on the cam. In reassembling the pointer shaft drive gear, set the gear so that the pointer shaft has approximately 0.003 inch end play.

(3) Excessive backlash between the worm and worm gear can be remedied by loosening the four screws around the one tachshaft coupling and adjusting same for proper clearance.

(4) Excessive play between the cross slide and its rollers can be corrected by loosening two of the screws securing the roller brackets and setting the rollers up against the cross slide.

(5) Lubrication at 1000 hour intervals is recommended as follows: Apply a small amount of light oil on the cross slide rollers, pointer shaft drive gear, and the bearing for the worm gear. Apply Beacon M-285 grease to the worm and to the edge of the cam.

n. TYPE MN-40D AZIMUTH INDICATOR DISASSEMBLY AND MAINTENANCE (See figure 36).—To gain access to the mechanism, proceed as follows:

(1) Remove the four screws in the back of the mounting plate, and lift off this plate.

(2) Remove the four screws thus exposed in the cam housing assembly, and lift off this assembly.

(3) If an attempt has been made to apply more than 20 degrees aircraft error correction, the cam strip may be bent, causing jumpy pointer action. If this is the case, return all adjusting screws toward their zero correction positions, being careful to proceed in a manner which reduces the stress at all positions proportionately. If with no correction applied, the cam strip still is kinked or uneven, it will be necessary to install a new cam strip. This is a rather difficult operation and should be performed only when proper tools are available.

(4) The compensator should slide freely and return to rest in the extended position shown in figure 36. The cam strip roller and the guide rollers should revolve very freely.

(5) There should be a minimum of backlash in the worm drive, and the worm shaft should not bind.

(6) The outer dial should rotate smoothly, but have sufficient friction to prevent its rotation with vibration.

o. TYPE MN-52G DISASSEMBLY AND MAINTENANCE.—The MN-52G and the MN-52J Azimuth Control is made using a die-cast aluminum base and a separate die-cast aluminum gear housing making for improved rigidity and simplified construction. All bearings are of the Oilite type and never need lubrication.

Access is gained to the mechanism by first removing crank (loosening two Bristo 6 x 32 set screws) and then loosening the three captive machine screws located on the front of control case (see figure 51). The cover will then lift off. NOTE: If cable plug AN3106-8S-1S in the MN-52G is disconnected before removing cover there will be less danger of short-circuiting the light power supply by striking the sides of the switch assembly against the inner connection of receptacle AN3102-8S-1P. This difficulty does not exist in the Type MN-52J.

Provision is made by means of split mountings for the mitre-gear bearings for the takeup of any backlash which might be encountered in the operation of the instrument. (NOTE: Backlash should always be kept at a minimum.) This adjustment should never have to be made, but in the event that it does become necessary the adjustment can be made by loosening the glyptal-fastened bearing clamp screws (Allen $\frac{1}{4}$ x 20 x $\frac{1}{2}$) and moving the appropriate mitre gear into closer contact with the mitre gear on the end of the crank shaft. Screws should then have glyptal applied before retightening.

On the back of the base of the instrument will be found four screws which hold the gear housing in place. If it ever should become necessary to adjust the relationship of the worm-gear to the dial pointer driver gear, the loosening of these screws will permit the shifting of the gear housing making this adjustment possible.

The instrument is housed in a case made of sheet aluminum and having a plastic window covering the dial. The case is finished in a gray wrinkle lacquer and is held in place by three captive machine screws. It is never necessary to remove the cover except for infrequent lubrication of the mitre and worm-gear mechanism. For this procedure grease of the grade of Beacon M285 should be used with care being taken to see that too much is not applied.

Replacement of the dial light (LM-2) is made by unscrewing (counter-clockwise) the lamp base located

just below the dial cover on the front of the cover and replacing with a new bulb.

CABLE CLAMP AN3057-3, a device for securing the power supply cable to PLUG AN3106-8S-1S and to offset the tendency toward excessive wear at this point has been made a part of the MN-52G equipment.

PLUG AN3106-8S-1S is now so arranged that when it is being removed and in case of its striking metal portions of the aircraft structure or the housing of MN-52G Azimuth Control, there is no danger of sparking or accidental short-circuiting of the power supply system. This is also true of Plug #BA30088 used on the MN-52J.

26. TYPICAL VACUUM TUBE SOCKET VOLTAGES.

Battery voltage, 14 or 28-volt. Equipment operating COMP. Threshold sensitivity COMPASS, loop gain and AUDIO controls are fully clockwise. Band switch on Band II. All voltages are measured to the chassis unless otherwise stated. Allowable tolerance of voltage variation ±10%. Measurements made with a 5000 ohms per volt d-c voltmeter. Plate and screen voltages measured on 250-volt scale. Heater, suppressor, and cathode voltages measured on 10-volt scale unless otherwise specified.

Tube	*Socket Terminal*	*Element*	*Voltage*
V1, 6K7 Loop amp.	2 to 7	Heater	6.4
	3	Plate	192
	4	Screen	97
	5	Suppressor	2.8
	8	Cathode	2.8
V2, 6N7 Audio Osc.	2 to 7	Heater	6.5
	3	Plate (P_2)	200
	6	Plate (P_1)	200
	8	Cathode	1.0
V3, 6N7 Mod.	2 to 7	Heater	6.4
	3	Plate (P_2)	170
	6	Plate (P_1)	170
	8	Cathode	10
V4, 6K7 1st RF	2 to 7	Heater	6.6
	3	Plate	170
	4	Screen	77
	5	Suppressor	0
	8	Cathode	3.0
V5, 6K7	2 to 7	Heater	6.4
	3	Plate	175
	4	Screen	75
	5	Suppressor	0
	8	Cathode	3
V6, 6L7 1st Det.	2 to 7	Heater	65
	3	Plate	1900
	4	Screen	85.0
	5	Grid #3	2.8
	8	Cathode	3.8
V7, 6J5 Het. Osc.	2 to 7	Heater	6.5
	3	Plate	62
	8	Cathode	0
V8, 6K7 IF Amp.	2 to 7	Heater	6.3
	3	Plate	167
	4	Screen	125
	5	Suppressor	0
	8	Cathode	4.7
V9, 6J5 CW Osc.	2 to 7	Heater	6.5
	3	Plate	*23
V10, 6B8 2nd Det	2 to 7	Heater	6.6
	3	Plate	75
	6	Screen	75
	8	Cathode	†15
V11, 6F6 Audio Amp.	2 to 7	Heater	6.6
	3	Plate	195
	4	Screen	210
	8	Cathode	†13
V12, 6K7 Comp. Amp.	2 to 7	Heater	6.4
	3	Plate	195
	4	Screen	65
	5	Suppressor	0
	8	Cathode	1.4

* CW ON. † 50 V Scale.

When vacuum tube socket voltages are found to vary appreciably from the typical values given in the above table, the trouble can usually be located as described below:

a. HEATER VOLTAGE HIGH.—Heater burned out in one of the tubes in the same parallel connected group. See figures 75 to 78.

b. HEATER VOLTAGE LOW.—Dirty contacts on S8. Heater burned out in one of the tubes in the other parallel connected group.

c. PLATE VOLTAGE HIGH.—Shorted plate resistor. Open screen or cathode circuit.

d. PLATE VOLTAGE LOW.—Ground on plate lead. Defective screen or cathode bypass capacitor. Defective plate coupling capacitor.

e. SCREEN VOLTAGE LOW.—Defective screen or cathode bypass capacitor.

f. CATHODE VOLTAGE HIGH.—Open cathode resistor R2 open. L2 or L3 open.

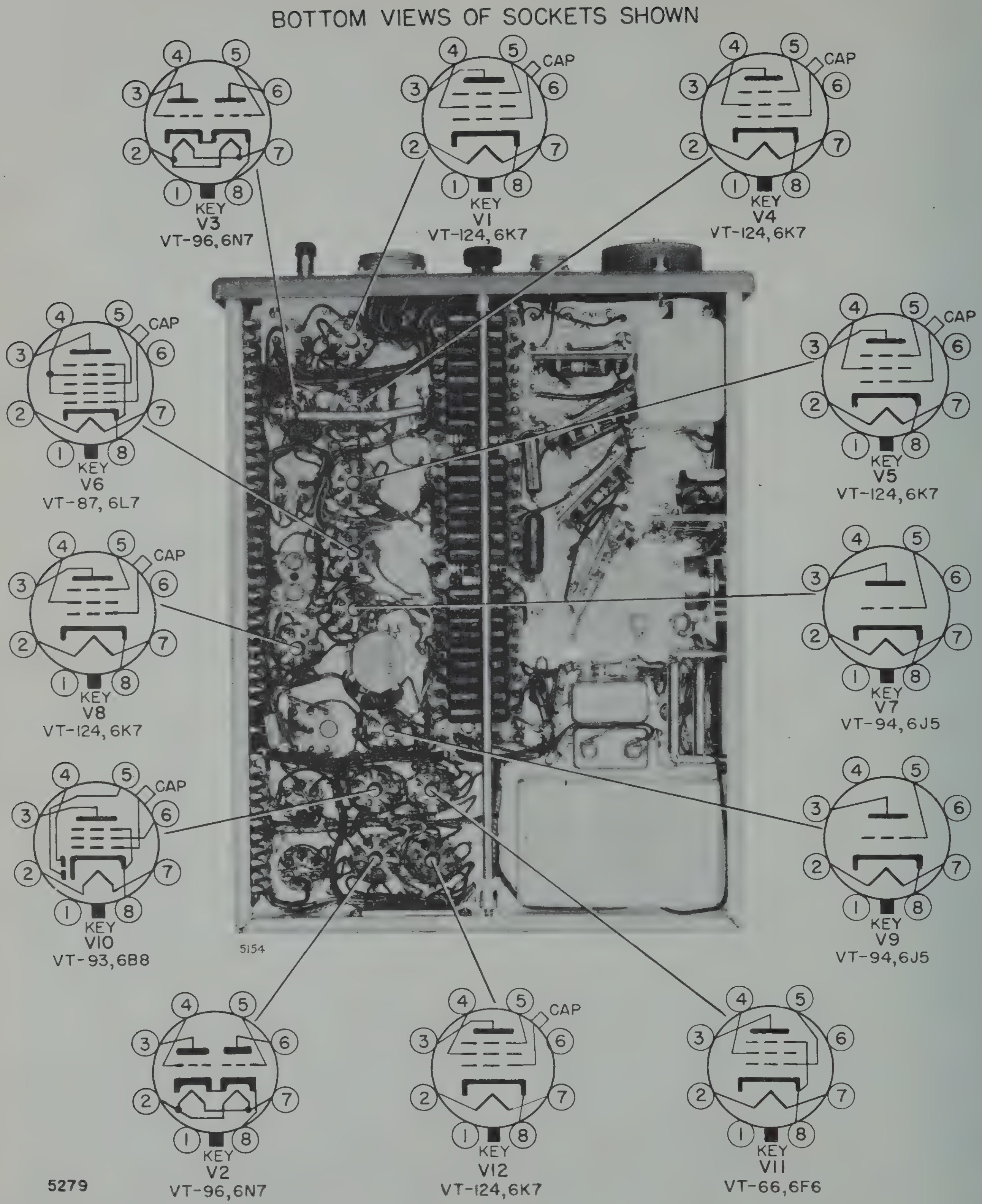


FIGURE 71 — TYPE MN-26 RADIO COMPASS, TUBE SOCKET LOCATION DIAGRAM

g. CATHODE VOLTAGE LOW.—Defective cathode bypass capacitor or resistor.

27. CONTINUITY TEST.

Remove cables and vacuum tubes from Type MN-26 Radio Compass and trace the following circuits with any good ohmmeter. The following tests must result in zero resistance (see figure 72). Any other reading will indicate a broken or high-resistance connection. Use the wiring diagram (figure 73) for tracing faulty connections.

From		*To*		*From*		*To*	
Element	*Terminal*	*Element*	*Terminal*	*Element*	*Terminal*	*Element*	*Terminal*
J4	3	TB2	37	TB1	58	T16	2
J4	3	J4	5	TB1	58	T16	6
J4	10	T16	5	TB1	58	TB2	50
J4	10	T15	5	TB1	58	TB2	25
J4	11	TB1	42	V7	1	T13	3
J4	12	TB2	36	V7	1	T13	6
J4	12	T15	3 or 4	V7	7	V8	7
J4	13	TB2	38	V8	1	T14	7
J4	14	TB2	39	V8	3	T14	4
J4	15	TB2	40	V9	5	L6	1
J4	16	TB1	40	V9	5	L6	6
J4	16	TB2	35	V9	6	V10	5
J4	17	TB1	21	V9	6	T14	1
J4	18	TB1	35	V9	7	V10	2
J4	19	TB1	62	V9	8	L6	3
J4	20	TB1	77	V10	1	T16	3
J4	21	T16	4	V10	4	T14	2
J4	23	TB1	39	V11	3	T15	1
TB2	6	PHASER	1	V11	4	CI0–1	
TB2	6	TB1	3	V11	4	T15	2
TB2	7	V1	4	V11	7	V12	2
TB2	7	TB1	85	V12	3	T16	1
TB2	8	V1	8	T13	2	T14	6
TB2	8	V1	5	TB1	2	TB1	3
TB2	8	TB1	1	TB1	4	TB1	5
TB2	31	T14	5	TB1	4	TB1	6
TB2	31	TB1	53	TB2	9	PHASER	4
TB2	32	V12	4	TB2	9	TB1	44
TB2	32	TB1	23	TB2	10	PHASER	3
TB2	33	V12	CAP	TB2	10	TB1	47
TB2	33	TB1	26	TB2	11	V3	8
TB2	34	TB1	43	TB2	11	TB1	5
TB2	37	TB1	69	TB2	12	L2, L3	3
TB2	41	V2	5	TB2	12	TB1	9
TB2	41	TB1	36	TB2	13	V4	4
TB2	42	V2	4	TB2	18	V5	4
TB2	42	TB1	37	TB2	18	TB1	15
TB2	48	TB1	80	TB2	19	L2, L3	2
TB1	8	V3	4	TB2	19	TB1	10
TB1	8	PHASER	5	TB2	21	V6	8
TB1	22	T13	4	TB2	21	TB1	11
TB1	24	V12	8	TB2	22	TB1	72
TB1	24	V12	5	TB2	23	V9	3
TB1	28	V8	4	TB2	23	TB1	20
TB1	29	T14	3	TB2	27	V6	4
TB1	31	V10	3	TB2	27	TB1	12
TB1	31	V10	6	TB2	29	V8	8
TB1	31	TB1	33	TB2	29	TB1	13
TB1	38	V11	5	TB2	30	V8	4
TB1	45	V2	6	TB2	31	V10	8
TB1	46	V2	3	TB1	58	TB2	15
TB1	48	V2	8	TB1	61	C7	

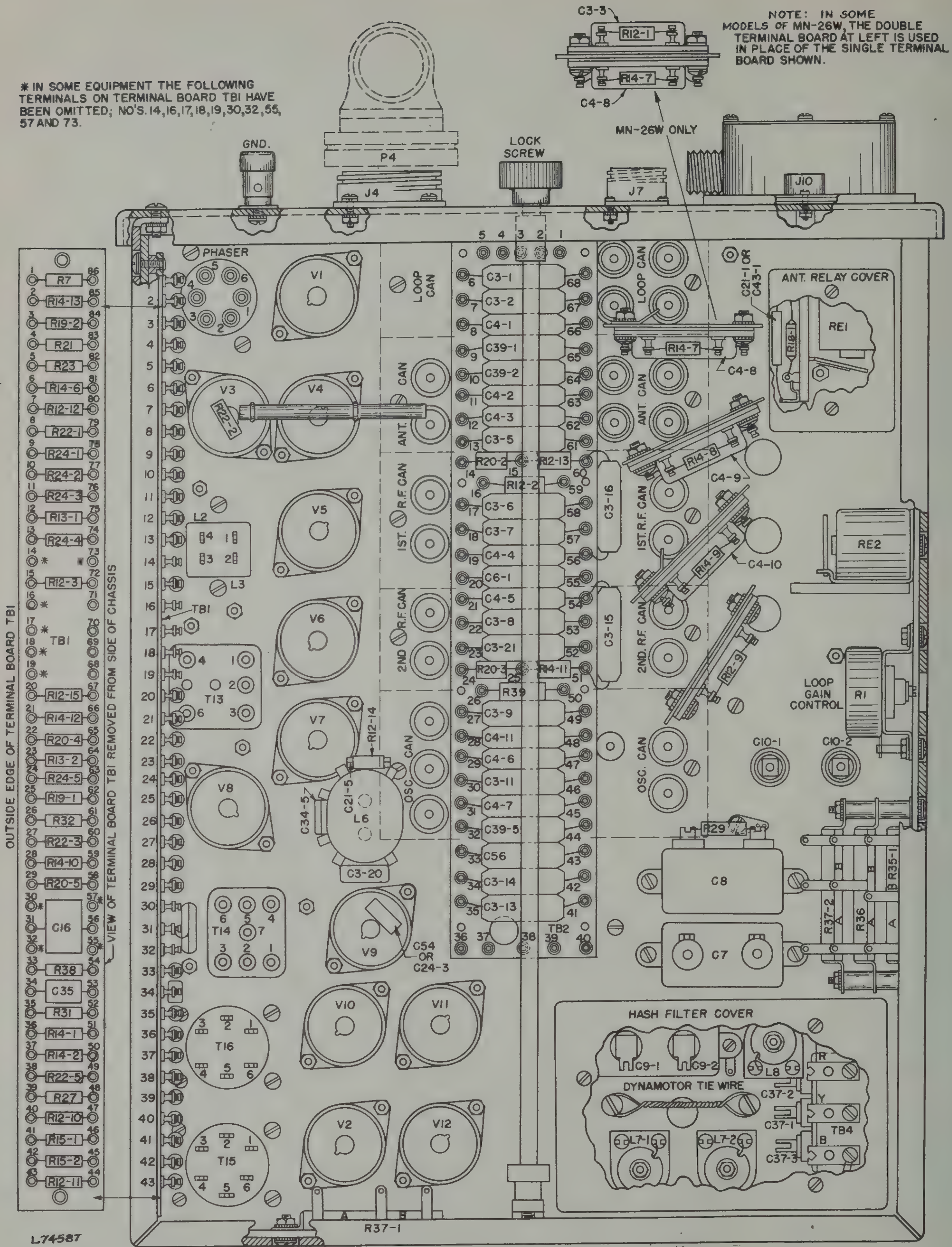


FIGURE 72 — TYPE MN-26 RADIO COMPASS, CONTINUITY TEST DIAGRAM

From		*To*		*From*		*To*	
Element	*Terminal*	*Element*	*Terminal*	*Element*	*Terminal*	*Element*	*Terminal*
TB1	66	L6	2	TB1	49	TB1	50
TB1	82	R1		TB1	49	TB1	51
V1	3	PHASER	6	TB1	49	TB1	60
V2	1	T15	6	TB1	49	TB1	63
V2	2	V3	2	TB1	49	TB1	71
V2	7	V11	2	TB1	49	TB1	74
V2	7	V10	7	TB1	49	TB1	86
V2	7	V8	2	TB1	52	TB1	53
V2	7	TB1	68	TB1	54	TB1	58
V2	7	V5	2	TB1	54	TB1	59
V2	7	V4	7	TB1	56	TB1	38
V3	7	TB1	70	TB1	64	TB1	65
V3	7	V7	2	TB1	67	TB1	83
V3	7	V6	7	TB1	67	TB1	84
V4	2	V1	7	TB1	75	TB1	76
V4	8	L2, L3	4	TB1	75	TB1	77
V5	7	V6	2	TB1	75	TB1	78
V5	8	L2, L3	1	TB1	79	TB1	80
V6	3	T13	1	TB1	79	TB1	81
TB1	7	TB1	82	TB2	13	TB2	59
TB1	25	TB1	26	TB2	26	TB2	27
TB1	25	TB1	27	TB2	14	TB2	16
TB1	33	TB1	34	TB2	14	TB2	17
TB1	40	TB1	41	TB2	22	TB2	24
TB1	42	TB1	43				

The following terminals must measure zero resistance to ground (chassis):

Element	*Terminal*	*Element*	*Terminal*	*Element*	*Terminal*
TB2	43	TB2	64	V4	5
TB2	44	TB2	65	V5	1
TB2	45	TB2	66	V5	5
TB2	46	TB2	67	V6	1
TB2	47	TB2	68	V7	1
TB2	49	TB2	20	V7	8
TB2	52	TB2	28	V8	1
TB2	53	TB2	44	V8	5
TB2	54	TB1	71	V9	1
TB2	56	J4	6	V9	2
TB2	57	V1	1	V10	1
TB2	58	V1	2	V11	1
TB2	61	V2	1	V12	1
TB2	62	V3	1	V12	7
TB2	63	V4	1	J7	3

The following resistance values must check within ±10%. The ohnmeter scale used is unimportant.

From	*To*	*Resistance (Ohms)*	*From*	*To*	*Resistance (Ohms)*
PHASER term 2	GROUND	500,000	L6 term 2	GROUND	OPEN
PHASER term 1	PHASER term 6	75	L6 term 3	L6 term 4	7
PHASER term 6	PHASER term 2	OPEN	L6 term 4	L6 term 5	0
PHASER term 6	PHASER term 3	OPEN	L6 term 3	L6 term 2	0.5
PHASER term 6	PHASER term 4	OPEN	L6 term 1	L6 term 2	OPEN
PHASER term 6	PHASER term 5	OPEN	L6 term 1	L6 term 6	0

From	*To*	*Resistance (Ohms)*
L6 term 5	L6 term 6	100,000
TB2 40	GROUND	OPEN
TB2 39	GROUND	9
TB2 38	GROUND	9
TB2 37	GROUND	5
TB2 36	GROUND	120
L2 term 3	L2 term 4	1
L3 term 1	L3 term 2	1
T13 term 1	T13 term 6	OPEN
T13 term 3	T13 term 6	0
T13 term 1	T13 term 4	10
T13 Grid cap	T13 term 2	100,000
T13 Grid cap	T13 term 3	OPEN
T14 term 4	GROUND	5,500
T14 term 4	T14 term 2	500,000
T14 term 4	T14 term 7	5,500
TB2 term 15	OSCILLATOR can term B+	50,000
TB2 term 16	TB2 term 59	100,000
TB2 term 26	TB2 term 50	25,000
OSCILLATOR can term GRID	V7 term 5	0
OSCILLATOR can term P	V7 term 3	0
OSCILLATOR can term. INJ. G	V6 term 5	0
RADIO FREQ.-2 can term P	V5 term 3	0
RADIO FREQ.-1 can term P	V4 term 3	0
ANTENNA can term P (rear)	V3 term 3	0
ANTENNA can term P (front)	V3 term 6	0
LOOP can term GND	GROUND	0
LOOP can term COND	C2-1 stator	0
ANTENNA can term B+	TB2 term 60	0
ANTENNA can term COND	C2-2 stator	0
RADIO FREQ.-1 can term COND	C2-3 stator	0
RADIO FREQ.-2 can term COND	C2-4 stator	0
OSCILLATOR can term GND	GROUND	0
OSCILLATOR can term COND	C2-5 stator	0
V11 term 8	GROUND	500
T14 term 2	T14 term 6	100,000
T14 term 1	T14 term 5	300,000
T14 Grid cap	T14 term 5	350,000
T16 term 1	T16 term 2	2,700
T16 term 6	T16 term 2	0
T16 term 6	T16 term 5	300
T16 term 4	T16 term 3	13
T15 term 1	T15 term 2	500
T15 term 2	T15 term 5	300
T15 term 6	T15 term 3	120
T15 term 6	T15 term 4	300

From	*To*	*Resistance (Ohms)*
T15 term 6	T15 term 5	220
V2 term 7	GROUND	75.6
V12 term 2	GROUND	12.6
T14 term 6	RADIO FREQ.-2 can term AVC	50,000
T14 term 6	RADIO FREQ.-1 can term AVC	50,000
T14 term 6	ANTENNA can term AVC	50,000
T14 term 6	TB2 term 55	0
J10	ANTENNA can term ANT	0
J10	GROUND	1,000,000
J4 term 9	GROUND	100
J7 term 1	LOOP can term LOOP	0
J7 term 5	LOOP can term LOOP	0
TB2 term 60	ANTENNA can term B+	0
TB2 term 60	TB2 term 15	100,000
TB2 term 15	RADIO FREQ.-1 can term B+	5,000
TB2 term 15	RADIO FREQ.-2 can term B+	5,000
TB1 term 43	TB1 term 44	100,000
TB1 term 45	TB1 term 42	2,000
TB1 term 46	TB1 term 41	2,000
TB1 term 47	TB1 term 40	100,000
TB1 term 48	TB1 term 39	100
TB1 term 49	TB1 term 38	500,000
TB1 term 50	TB1 term 37	50,000
TB1 term 51	TB1 term 36	50,000
TB1 term 52	TB1 term 35	3,000
TB1 term 53	TB1 term 34	OPEN
TB1 term 54	TB1 term 33	25,000
TB1 term 56	TB1 term 31	500,000
TB1 term 58	TB1 term 29	5,000
TB1 term 59	TB1 term 28	50,000
TB1 term 60	TB1 term 27	500,000
TB1 term 61	TB1 term 26	300,000
TB1 term 62	TB1 term 25	1,000
TB1 term 63	TB1 term 24	600
TB1 term 64	TB1 term 23	150,000
TB1 term 65	TB1 term 22	5,000
TB1 term 66	TB1 term 21	50,000
TB1 term 67	TB1 term 20	100,000
TB1 term 72	TB1 term 15	100,000
TB1 term 74	TB1 term 13	600
TB1 term 75	TB1 term 12	150,000
TB1 term 76	TB1 term 11	600
TB1 term 77	TB1 term 10	600
TB1 term 78	TB1 term 9	600
TB1 term 79	TB1 term 8	500,000
TB1 term 80	TB1 term 7	vary with rotation of R1
TB1 term 81	TB1 term 6	
TB1 term 82	TB1 term 5	
TB1 term 83	TB1 term 4	
TB1 term 84	TB1 term 3	1,000
TB1 term 85	TB1 term 2	50,000
TB1 term 86	TB1 term 1	300

28. OVERALL PERFORMANCE CHARACTERISTICS.

a. GENERAL.—If at any time operation of the equipment is questionable, the performance with the equipment should be measured in accordance with the following typical procedures and values. After making any major repairs or adjustments, performance should be measured to insure that the adjustments have been properly made.

b. STANDARD TEST CONDITIONS.—For these tests the following conditions should be maintained unless otherwise stated:

(1) SIGNAL-TO-NOISE RATIO.—4 to 1 in power, 2 to 1 in voltage. The noise output is 12.5 milliwatts when standard output is 50 milliwatts or 7 volts when standard output is 14.1 volts.

(2) STANDARD OUTPUT.—50 milliwatts or 14.1 volts (signal and noise). This output may be obtained from either of the remote control unit jacks with plug out of the other jack. On receiver operation adjust AUDIO control for standard signal-to-noise ratio. On COMP. adjust AUDIO control for maximum output.

(3) ARTIFICIAL ANTENNA.—Receiver 100 mmf, compass 100 mmf, and one-half meter effective height, except for MN-26M, MN-26W and MN-26X for which sets the foregoing values are reduced one-half (50 mmf and $\frac{1}{4}$ meter).

(4) STANDARD MODULATION SIGNAL.—30%, 400 cycles per second.

(5) WARM UP PERIOD.—20 minutes.

(6) LOW VOLTAGE SUPPLY.—14 or 28 volts.

c. SENSITIVITY: REC. ANT.—Apply the standard modulated signal to the antenna terminal through an artificial antenna. Set generator output at approximately 5 microvolts. Carefully tune the radio compass unit to resonance. Cut off modulation, leaving the carrier on. Set AUDIO control to obtain 12.5 milliwatts average noise output. Turn modulation on and set generator output to the value which gives 50 milliwatts receiver output. Turn off modulation and reset AUDIO control to obtain 12.5 milliwatts average noise output. Repeat until 50 milliwatts output is obtained with modulation on and 12.5 milliwatts noise with modulation off. Repeat above procedure for each test frequency. Record receiver input on a form similar to that contained in section V, paragraph 28*j*.

d. MINIMUM NOISE LEVEL.—Minimum noise level can be measured by operating on REC. ANT. and turning AUDIO control to minimum. Output levels greater than 0.050 milliwatts indicate trouble in dynamotor, filtering, or second detector and audio circuits.

e. INTERMEDIATE FREQUENCY REJECTION RATIO.—Measure REC. ANT. sensitivity at test frequency (150 kcs or 200 kcs). Set signal generator at point of greatest response near 112.5 kcs and increase its output until 50 milliwatts receiver output is obtained. The ratio of the attenuator setting at 112.5 kcs and at the test frequency is the rejection ratio. Record this data on a form similar to that contained in section V, paragraph 28*j*.

NOTE

The harmonics of the signal will appear in the frequency range of the equipment (i.e. 225, 337.5, etc.). To avoid response from harmonics select a test frequency half way between these harmonics.

f. IMAGE REJECTION RATIO.—Measure REC. ANT. sensitivity of equipment first at test frequency and again with signal generator set 225 kcs above the test frequency. Do not disturb tuning of equipment but vary the signal generator frequency slightly until maximum response is obtained. The ratio of the signal generator output of the two settings is the image rejection ratio. Record this data on a form similar to that in section V, paragraph 28*j*.

g. AVC ACTION.—Operate on REC. ANT., audio control maximum. Apply a standard modulated signal to the antenna terminal through a 100 mmf artificial antenna (except MN-26M, MN-26W, and MN-26X, which require a 50 mmf artificial antenna). Record milliwatts output against microvolts input on a form similar to that of section V, paragraph 28*j*. The test frequency generally used is 655 kcs.

h. SELECTIVITY: REC. ANT.—Measure REC. ANT. sensitivity of equipment at the high frequency end of each band. Increase the signal generator attenuator setting so that the output is 1000 times that of the measured sensitivity. Vary signal generator frequency above and below resonance until output equals original test output. Record the band width on a form similar to that of section V, paragraph 28*j*.

i. SENSITIVITY: REC. LOOP.—Mount loop beneath the reference transmission line. Operate on REC. LOOP. Turn loop for maximum pick-up. Adjust AUDIO control for a signal to noise power ratio of 4 to 1 as done for REC. ANT. sensitivity measurement of section V, paragraph 28*c*. Record microvolts per meter field strength at the center of the loop for standard receiver output on a form similar to section V, paragraph 28*j*.

j. MINIMUM PERFORMANCE DATA.

Para-graph Ref. No.	Compass Type Number	*MN-26A, MN-26C, MN-26CA, MN-26Y*			*MN-26M, MN-26W, MN-26X*			*MN-26A, MN-26C, MN-26CA, MN-26Y*			*MN-26M, MN-26W, MN-26X*			*MN-26A, MN-26C, MN-26CA*			*MN-26W, MN-26X*			*MN-26M, MN-26Y*		
	Test Point	*Band I*			*Band I*			*Band II*			*Band II*			*Band III*			*Band III*			*Band III*		
		Low	*Med.*	*Hi*	*Low*	*Med.*	*Hi*	*Low*	*Med.*	*Hi*	*Low*	*Med.*	*Hi*	*Low*	*Med.*	*Hi*	*Low*	*Med.*	*Hi*	*Low*	*Med.*	*Hi*
	Test Freq. (kcs)	180	220	325	200	300	410	325	470	695	410	600	850	695	1100	1500	850	1200	1750	3400	4000	7000
28*c*	Rec. Ant. Sens. (μv)	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	12	12	12
28*e*	I-F Rejection Ratio	32M:1		100M:1	10M:1		32M:1	100M:1		100M:1	32M:1		100M:1	100M:1			100M:1					
28*f*	Image Rejection Ratio			10M:1			10M:1			32M:1			15M:1			15M:1			3M:1			32D:1
28*i*	Loop Sens. (μv/M)	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120			
28*k*	Compass Sensitivity, Uniformity, and Accuracy — 100 μv/M — O	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°	±4°				
	R		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
	L		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
	1000 μv/M — O	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°			
	R		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
	L		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
	100M μv/M — O	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°	±2°			
	R		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
	L		3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°			3° to 27°				
28*h*	Rec. Ant. Sel. Res. Input Band Width ×1000			14			16			17			19			22			23			26
28*g*	AVC Action Med. 30%, Test Freq. 655 kcs.	Input—Range from 15 microvolts to 1 volt. Output—Range of 5 decibels																				

k. COMPASS SENSITIVITY UNIFORMITY AND ACCURACY.—Mount the loop beneath the reference transmission line. Operate on COMP. Use a 100 mmf, 0.5 meter artificial antenna. At 800 kcs (or 50 mmf, 0.25 meter for Types MN-26-M, W, and X). Adjust COMPASS control so that a 15 degree rotation of the loop produces full scale indicator deflection, with an input of 1000 μ V/M at the center of the loop. Without changing COMPASS control setting, record the degrees rotation of loop required to produce zero and full-scale right and left indicator pointer deflection for 50, 100, and 100,000 microvolts per meter input at different test frequencies on a form similar to that of section V, paragraph 28*j*.

l. INPUT FOR FULL SCALE INDICATOR DEFLECTION.—This test requires a well shielded compass test room. Mount loop beneath the reference transmission line. COMPASS control on maximum. Apply applicable test frequency signal of 1000 microvolts per meter field strength at the center of the loop. Record number of degrees loop rotation required for left and right full scale indicator deflection. Typical loop settings are 8 degrees left for full scale left deflection, 0 ($\pm$1 degree) for oncourse setting, and 8 degrees right for full scale right deflection.

SECTION VI

SUPPLEMENTARY DATA

29. TUBE COMPLEMENT.

The vacuum tubes used in Type MN-26 Radio Compass perform the following function:

Ref. No.	*Commercial Type No.*	*Function*
V1	6K7	Loop Amplifier
V2	6N7	Audio Oscillator
V3	6N7	Modulator
V4	6K7	1st R-F Amplifier
V5	6K7	2nd R-F Amplifier
V6	6L7	1st Detector
V7	6J5	Heterodyne Oscillator
V8	6K7	I-F Amplifier
V9	6J5	C-W Oscillator
V10	6B8	2nd Detector
V11	6F6	Audio Amplifier
V12	6K7	Compass Amplifier

No other component of the radio compass equipment uses vacuum tubes.

30. SUMMARY.

a. FREQUENCY RANGE.—The frequency range and type of operation is as follows:

(1) TYPES MN-26A, AND MN-26CA RADIO COMPASSES.

Band	*Frequency Range (Kilocycles)*	*Function Switch Position*			
		Visual-Unidirectional Left-Right Indication	*Aural Reception with Loop Antenna*	*Aural-Null Directional Reception*	*Aural Reception with Non-Directional Antenna*
I	150–325	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
II	325–695	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
III	695–1500	COMP.	REC. LOOP	REC. LOOP	REC. ANT.

(2) TYPE MN-26M RADIO COMPASS.

Band	*Frequency Range (Kilocycles)*	*Function Switch Position*			
		Visual-Unidirectional Left-Right Indication	*Aural Reception with Loop Antenna*	*Aural-Null Directional Reception*	*Aural Reception with Non-Directional Antenna*
I	200–410	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
II	410–850	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
III	3400–7000	NOT AVAILABLE			REC. ANT.

(3) TYPES MN-26W, AND MN-26X RADIO COMPASSES.

Band	*Frequency Range (Kilocycles)*	*Function Switch Position*			
		Visual-Unidirectional Left-Right Indication	*Aural Reception with Loop Antenna*	*Aural-Null Directional Reception*	*Aural Reception with Non-Directional Antenna*
I	200–410	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
II	410–850	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
III	850–1750	COMP.	REC. LOOP	REC. LOOP	REC. ANT.

(4) TYPE MN-26Y RADIO COMPASS.

Band	Frequency Range (Kilocycles)	Function Switch Position			
		Visual-Unidirectional Left-Right Indication	Aural Reception with Loop Antenna	Aural-Null Directional Reception	Aural Reception with Non-Directional Antenna
I	150–325	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
II	325–695	COMP.	REC. LOOP	REC. LOOP	REC. ANT.
III	3400–7000	NOT AVAILABLE			REC. ANT.

There are no pre-set frequencies.

b. ANTENNA CHARACTERISTICS.—The non-directional vertical antenna should have an effective height of one-half meter, a capacity of 100 micro-micro-farads, and a resistance between 1 to 10 ohms.

c. POWER REQUIREMENTS.

(1) DYNAMOTOR.—The dynamotor supplies plate voltage to the equipment.

(*a*) INPUT.—28 volts, 1.6 amperes (or 14 volts, 3.2 amperes).

(*b*) OUTPUT.—230 volts, 100 milliamperes.

(*c*) TEMPERATURE RISE.—40 degrees centigrade.

(*d*) REVOLUTIONS PER MINUTE.—4600 RPM.

(*e*) DUTY.—Continuous.

(*f*) MANUFACTURER.—Due to difficulty in procuring large numbers of dynamotors from any one vendor, the Type MN-26 Radio Compass may be supplied with any one of the following.

Manufacturer	Type Numbers	
	28 Volt Models	14 Volt Models
Bendix	DA-1A	DA-1B
Eicor	ML3415 PS21	ML3415-20
Pioneer	SP125 SS2041	SP125 SS2017
Redmond	L74764	..

(2) BAND SWITCH MOTOR.

(*a*) POWER CONSUMPTION.—24 volts, 1.25 amperes (or 12 volts, 2.5 amperes).

(*b*) MANUFACTURER.—Band switch motors are supplied by three manufacturers as follows:

Manufacturer	28 Volt Models	14 Volt Models
Pioneer	BX100-W-988	BX100-W-988
Eicor	1610-12	1610-2
Bendix	E11500-1	E11500-2
Redmond	C58519	..

d. POWER CONSUMPTION.—The primary input requirement is normally 28 volts, 3 amperes (or 14 volts, 6 amperes) and when changing bands is 28 volts, 4.25 amperes (or 14 volts, 8.5 amperes).

31. CONVERSION OF EQUIPMENT.

a. CONVERSION FROM 28 to 14 VOLT OPERATION.—If it is necessary to convert the equipment for use with a 14 volt primary power source in place of the 28 volt for which it is designed, make the following simple changes:

(1) Replace the 28 volt band switch motor (E11500-1) with a 14 volt motor (E11500-2).

(2) Replace the 28 volt dynamotor (C56728-2) with a 14 volt dynamotor (C56728-1).

(3) Solder a wire jumper across the terminals of resistor R37-2. Resistance should now be zero.

(4) Solder a wire jumper across the B section (67 ohms) of resistor R35-1. Resistance of R35-1 should now be 50 ohms.

(5) Solder a wire jumper across the B section (75 ohms) of resistor R36. Resistance of R36 should now be 120 ohms.

(6) Remove the jumper which connects terminals 69 and 70 of terminal board TB1.

(7) Solder a wire jumper across terminals 68 and 69 of terminal board TB1.

(8) Solder a wire jumper across terminals 70 and 71 of terminal board TB1.

(9) Clearly mark the revised radio compass to indicate that it is to be used on a 14 volt source.

(10) Solder a wire jumper across the B section (67 ohms) of resistor R35-1. Resistance should now be 50 ohms.

(11) Clearly mark the revised remote control unit to indicate that it is to be used on a 14 volt source.

b. CONVERSION FROM 14 to 28 VOLT OPERATION.—Reverse the procedure described in section V, paragraph 31*a*.

c. CONVERSION OF EQUIPMENT FOR HIGH IMPEDANCE OUTPUT.—If it is desirable to convert the equipment from low impedance (600 ohms) output to high impedance (4000 ohms) output, make the following simple changes:

(1) TYPE MN-26 RADIO COMPASS.—Unsolder the yellow wire from terminal 3 and solder it to terminal 4 of transformer T15.

(2) TYPE MN-28 REMOTE CONTROL.—Replace the AUDIO control (R4A and R4B) L72704-1 with A14550. Mark the revised remote control to indicate that this change has been made.

d. CONVERSION TO AUTOMATIC COMPASS OPERATION.—The left-right manual compass described in this book may be converted for automatic compass operation with the addition of units described in the "Instruction Book for Model MN-31 Series Automatic Radio Compass Equipment for Aircraft" and by converting the Type MN-26 Radio Compass as described in Bendix Engineering Service Note BS-29.

32. SUMMARY OF OPERATION.

The following table lists the positions of controls for the various functions of the equipment:

Position of Controls	*Function of Equipment*						
	Homing			*Direction Finding*		*Radio Reception*	
	Radio Range	*Visual (Radio Compass)*	*Aural-Null*	*Visual Bearings*	*Aural-Null Bearings*	*With Non-Directional Antenna*	*With Loop (Anti-Rain-Static)*
MN-28							
Function switch	REC. ANT.	COMP.	REC. LOOP	COMP.	REC. LOOP	REC. ANT.	REC. LOOP
COMPASS control	Not used	Maximum	Not used	Adjust for desired IN-4A sensitivity	Not used	Not used	Not used
AUDIO control	Adjust for desired volume	As desired	Adjust for desired width of null	As desired	Adjust for desired width of null	Adjust for desired volume	Adjust for desired volume
C.W ON-OFF	As desired	As desired	ON	As desired	ON	As desired	As desired
MR-15A Crank drive	Not used	Rotate for zero (0) reading of MN-22A or MN-40D	Rotate for zero (0) reading of MN-22A or MN-40D	Rotate for on-course indication on IN-4A	Rotate for minimum head-set volume	Not used	Rotate for maximum volume
IN-4A	Not used	Turn ship in direction indicated until pointer returns to center	Not used	Rotate MR-15A until pointer returns to center	Not used	Not used	Not used
MN-22A or MN-40D, MN-52G	Not used	0	0	When on-course correct for aircraft heading and read bearing	Read bearing when volume is minimum	Not used	Not used

33. MISCELLANEOUS TABLES.

a. CURRENT CAPACITY OF POWER WIRING.

Gauge Number B & S	*Circular Mil Area*	*Amperes*	
		Rubber Insulation	*Other Insulation*
1	83690	100	150
2	66370	90	125
4	41740	70	90
6	26250	50	70

Gauge Number B & S	*Circular Mil Area*	*Amperes*	
		Rubber Insulation	*Other Insulations*
8	16510	35	50
10	10380	25	30
12	6530	20	25
14	4107	15	20
16	2583	6	10
18	1624	3	6

b. WIRE AND METAL GAUGES.

Gauge No.	*Diameter in Inches*			*Ohms per 1000 Feet (Copper, B & S, 25°C)*	*Nearest British Equiv. (B. W. S.)*
	*B & S**	*U. S. S.†*	*Birm.‡*		
1	.2893	.28125	.300	.1264	1
2	.2576	.265625	.284	.1593	3
3	.2294	.25	.259	.2009	4
4	.2043	.234375	.238	.2533	5
5	.1819	.21875	.220	.3195	7
6	.1620	.203125	.203	.4028	8
7	.1443	.1875	.180	.5080	9
8	.1285	.171875	.165	.6405	10
9	.1144	.15625	.148	.8077	11
10	.1019	.140625	.134	1.018	12
11	.09074	.125	.120	1.284	13
12	.08081	.109375	.109	1.619	14
13	.07196	.09375	.095	2.042	15
14	.06408	.078125	.083	2.575	16
15	.05707	.0703125	.072	3.247	17
16	.05082	.0625	.065	4.094	18
17	.04526	.05625	.058	5.163	18
18	.04030	.05	.049	6.510	19
19	.03589	.04375	.042	8.210	20
20	.03196	.0375	.035	10.35	21
21	.02846	.034375	.032	13.05	22
22	.02535	.03125	.028	16.46	23
23	.02257	.028125	.025	20.76	24
24	.02010	.025	.022	26.17	25
25	.01790	.021875	.020	33.00	26
26	.01594	.01875	.018	41.62	27
27	.01420	.0171875	.016	52.48	29
28	.01264	.015625	.014	66.17	30
29	.01126	.0140625	.013	83.44	31
30	.01003	.0125	.012	105.2	33
31	.008928	.0109375	.010	132.7	34
32	.007950	.01015625	.009	167.3	36
33	.007080	.009375	.008	211.0	37
34	.006350	.00859375	.007	266.0	38
35	.005615	.0078125	.005	335.0	38–39
36	.005000	.00703125	.004	423.0	39–40
37	.004453	.006640626		533.4	41
38	.003965	.00625		672.6	42
39	.003531	..		848.1	43
40	.003145	..		1069	44

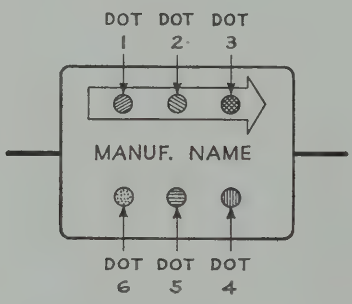
* American or B & S.—Used for aluminum, copper, brass and non-ferrous alloy sheets, wire and rods.
† U. S. Standard.—Used for iron, steel, nickel and ferrous alloy sheets, wire and rods.
‡ Birmingham or Stubs.—Used for seamless tubes; also by some manufacturers for copper and brass.

c. DECIMAL EQUIVALENTS OF FRACTIONS.

Fraction	Decimal	Fraction	Decimal	Fraction	Decimal
1/64	.0156	11/32	.3437	43/64	.6718
1/32	.0312	23/64	.3593	11/16	.6875
3/64	.0468	3/8	.3750	45/64	.7031
1/16	.0625	25/64	.3906	23/32	.7187
5/64	.0781	13/32	.4062	47/64	.7343
3/32	.0937	27/64	.4218	3/4	.75
7/64	.1093	7/16	.4375	49/64	.7656
1/8	.1250	29/64	.4531	25/32	.7812
9/64	.1406	15/32	.4687	51/64	.7968
5/32	.1562	31/64	.4843	13/16	.8125
11/64	.1718	1/2	.5	53/64	.8281
3/16	.1875	33/64	.5156	27/32	.8437
13/64	.2031	17/32	.5312	55/64	.8593
7/32	.2187	35/64	.5468	7/8	.8750
15/64	.2343	9/16	.5625	57/64	.8906
1/4	.25	37/64	.5781	29/32	.9062
17/64	.2656	19/32	.5937	59/64	.9218
9/32	.2812	39/64	.6093	15/16	.9375
19/64	.2968	5/8	.6250	61/64	.9531
5/16	.3125	41/64	.6406	31/32	.9687
21/64	.3281	21/32	.6562	63/64	.9843

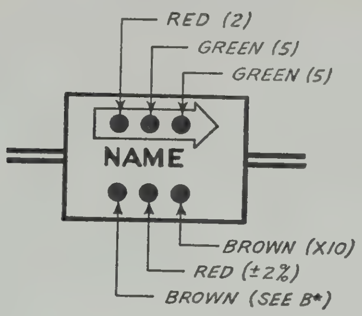
d. RMA COLOR CODE FOR RESISTORS AND CAPACITORS.

(1) AMERICAN WAR STANDARD 6-DOT COLOR CODE CHART FOR CAPACITORS (MOLDED MICA).



Color	1st Dot	2nd Dot	3rd Dot	4th Dot	5th Dot	6th Dot
	1st Digit	2nd Digit	3rd Digit	Decimal Multiplier	Tolerance	See Below*
Black	0	0	0	1	±20%	A*
Brown	1	1	1	10		B*
Red	2	2	2	100	±2%	C*
Orange	3	3	3	1,000		D*
Yellow	4	4	4	10,000		E*
Green	5	5	5	100,000		F*
Blue	6	6	6	1,000,000		G*
Violet	7	7	7	10,000,000		
Gray	8	8	8	100,000,000		
White	9	9	9	1,000,000,000		
Gold				0.1	±5%	
Silver				0.01	±10%	

*Values are in micro-microfarads.



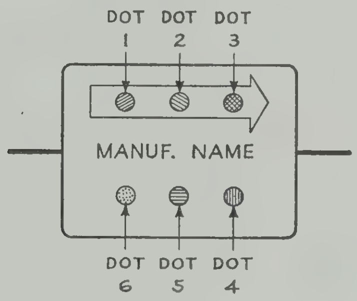
Example

2550 micro-microfarads; ±2%; mica-dielectric; low-loss case.

Significance of 6th dot;

A*—Ordinary Mica By-Pass.
B*—Same as A*—Low-loss case.
C*—By-Pass or Silver Mica Capacitor (±200 parts/million/C).
D*—Silver Mica Capacitor (±100 parts/million/C).
E*—Silver Mica Capacitor (0 to +100 parts/million/C).
F*—Silver Mica Capacitor (0 to +50 parts/million/C).
G*—Silver Mica Capacitor (0 to −50 parts/million/C).

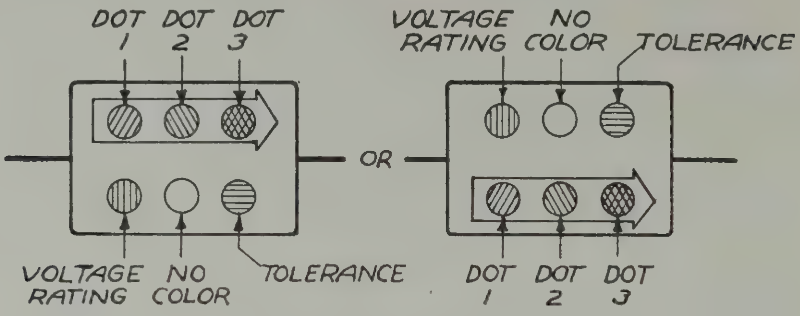
(2) RMA STANDARD 6-DOT COLOR CODE CHART FOR CAPACITORS.



Color	*1st Dot*	*2nd Dot*	*3rd Dot*	*4th Dot*	*5th Dot*	*6th Dot*
	1st Digit	*2nd Digit*	*3rd Digit*	*Decimal Multiplier*	*Tolerance*	*Voltage*
Black	0	0	0	1		
Brown	1	1	1	10	1%	100v
Red	2	2	2	100	2%	200v
Orange	3	3	3	1,000	3%	300v
Yellow	4	4	4	10,000	4%	400v
Green	5	5	5	100,000	5%	500v
Blue	6	6	6	1,000,000	6%	600v
Violet	7	7	7	10,000,000	7%	700v
Gray	8	8	8	100,000,000	8%	800v
White	9	9	9	1,000,000,000	9%	900v
Gold				0.1		1,000v
Silver				0.01	10%	2,000v
Body					20%	500v

Values are in micro-microfarads.

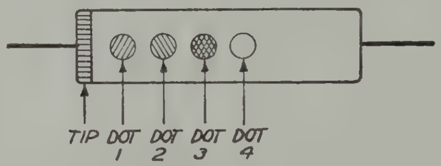
(3) 3-DOT COLOR CODE CHART FOR CAPACITORS.



Color	1st Dot	2nd Dot	3rd Dot	Tolerance	Voltage
	1st Digit	2nd Digit	Decimal Multiplier		
Black	0	0	1		
Brown	1	1	10	1%	100v
Red	2	2	100	2%	200v
Orange	3	3	1,000	3%	300v
Yellow	4	4	10,000	4%	400v
Green	5	5	100,000	5%	500v
Blue	6	6	1,000,000	6%	600v
Violet	7	7	10,000,000	7%	700v
Gray	8	8	100,000,000	8%	800v
White	9	9	1,000,000,000	9%	900v
Gold			0.1		1,000v
Silver			0.01	10%	2,000v
Body				20%	*

Values are in micro-microfarads.
* When no color is indicated the Voltage Rating may be as low as 300 volts.

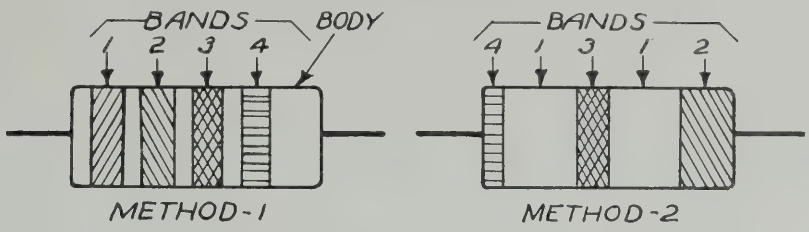
(4) COLOR CODE CHART FOR TUBULAR CERAMIC CAPACITORS.



Color	Tip	1st Dot	2nd Dot	3rd Dot	4th Dot
	Temperature Coefficient	1st Digit	2nd Digit	Decimal Multiplier	Tolerance
Black	0	0	0	1	
Brown	.00003 Neg.	1	1	10	1%
Red	.00008 Neg.	2	2	100	2%
Orange	.00015 Neg.	3	3	1,000	3%
Yellow	.00022 Neg.	4	4	10,000	4%
Green	.00033 Neg.	5	5	100,000	5%
Blue	.00047 Neg.	6	6	1,000,000	6%
Violet	.00075 Neg.	7	7	10,000,000	7%
Gray		8	8	0.1	
White		9	9	0.01	10%

Values are in micro-microfarads.

(5) RMA COLOR CODE CHART FOR RESISTORS.



Color	*1st Band* / *1st Digit*	*2nd Band* / *2nd Digit*	*3rd Band* / *Decimal Multiplier*	*4th Band* / *Tolerance*
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Violet	7	7	10,000,000	
Gray	8	8	100,000,000	
White	9	9	1,000,000,000	
Gold				±5%
Silver				±10%
No Color				±20%

Values are in ohms.

In the new types, the body color indicates resistance material as follows: Black—Composition, Non-insulated Tan, Olive, or White—Composition, Insulated Dark Brown—Wire-wound, Insulated.

SECTION VII

TABLE OF REPLACEABLE PARTS

34. USE OF TABLE.

In the tables which list the parts for several models of the same kind of equipment, there is a "USED ON" column. The "USED ON" column is subdivided into columns, each of which is headed by the type number of the model represented. An "X" in the column indicates that the part described is used in the type number which heads that column, while the absence of an "X" indicates that the part is not used in that model. For example: the capacitor C1-3 is used in Types MN-26A, C, CA, W, and X as indicated by an "X" in the proper columns, but is not used in Types MN-26M or MN-26Y.

In the table of replaceable parts for "Type MN-26 Radio Compass Series", an additional column headed "LOCATION OF PART (PART OF)" is included to help locate the part on the diagrams, illustrations, and in the equipment.

35. TABLE OF REPLACEABLE PARTS.

a. TYPE MN-26 RADIO COMPASS SERIES

CTC. Sym.	*Used on Radio Compass*				*Function of Part*	*Location of Part (Part of)*	*Bendix Part Number*	*Description*
	MN-26A C or CA	*MN-26M*	*MN-26X, MN-26W*	*MN-26Y*				
					CAPACITORS			
C1-1	x	x	x	x	Loop Trimmer, Band 1	Loop Can	QB7751-25	6 to 25 Mmf ±10%, 500 V DCW, Variable, Air Dielectric, Right Hand Terminal
C1-2	x	x	x	x	Loop Trimmer, Band 2	Loop Can		
C1-3	x		x		Loop Trimmer, Band 3	Loop Can		
C1-4	x	x	x	x	Ant. Trimmer, Band 1	Ant. Can		
C1-5	x	x	x	x	Ant. Trimmer, Band 2	Ant. Can		
C1-6	x	x	x	x	Ant. Trimmer, Band 3	Ant. Can		
C1-7	x	x	x	x	1st RF Trimmer, Band 1	1st RF Can		
C1-8	x	x	x	x	1st RF Trimmer, Band 2	1st RF Can		
C1-9	x	x	x	x	1st RF Trimmer, Band 3	1st RF Can		
C1-10	x	x	x	x	2nd RF Trimmer, Band 1	2nd RF Can		
C1-11	x	x	x	x	2nd RF Trimmer, Band 2	2nd RF Can		
C1-12	x	x	x	x	2nd RF Trimmer, Band 3	2nd RF Can		
C1-13	x	x	x	x	HF Osc. Trimmer, Band 1	Osc. Can	QB7783-25	Same as C1-1 to C1-12 except Left Hand Terminal
C1-14	x	x	x	x	HF Osc. Trimmer, Band 2	Osc. Can		
C1-15	x	x	x	x	HF Osc. Trimmer, Band 3	Osc. Can		
C2-1	x	x	x	x	Loop Tuning		L70943 or L74607	5-Section, Variable, Each section 12.5 to 400 Mmf ±10% Oak Mfg. Co.
C2-2					Ant. Tuning			
C2-3					1st RF Tuning			
C2-4					2nd RF Tuning			
C2-5					HF Osc. Tuning			
C3-1	x	x	x	x	V1 Plate Bypass	TB2	A18015-503	.05 Mfd ±10%, 400V DCW, Paper
C3-2	x	x	x	x	V1 Screen Bypass	TB2		
*C3-3			x		V1 AVC Filter			
C3-5	x	x	x	x	V4 Screen Bypass	TB2		
C3-6	x	x	x	x	V4 Plate Bypass	TB2		
C3-7	x	x	x	x	V5 Screen Bypass	TB2		
C3-8	x	x	x	x	V5 Plate Bypass	TB2		
C3-9	x	x	x	x	V6 Screen Bypass	TB2		

* Not used in later models of Type MN-26W.

CTC. Sym.	*Used on Radio Compass*				*Function of Part*	*Location of Part (Part of)*	*Bendix Part Number*	*Description*
	MN-26A C or CA	*MN-26M*	*MN-26X, MN-26W*	*MN-26Y*				
					CAPACITORS—Continued			
C3-10	x	x	x	x	V8 Plate Bypass	T14	A108719-503	.05 Mfd +30 −15%, 400V DCW, Paper
C3-11	x	x	x	x	V8 Screen Bypass	TB2		
C3-12	x	x	x	x	V6 Plate Bypass	T13		
C3-13	x	x	x	x	V2 Grid Coupling	TB2	A18015-503	.05 Mfd ±10%, 400V DCW, Paper
C3-14	x	x	x	x	V2 Grid Coupling	TB2		
C3-15	x	x	x	x	V7 Plate Bypass	TB2	A108719-503	.05 Mfd +30 −15%, 400V DCW, Paper
C3-16	x	x	x	x	V3 Plate Bypass	TB2		
C3-17	x	x	x	x	V9 Plate Bypass	TB2		
C3-18	x	x	x	x	V3 Grid Coupling, LF	Phaser	A18015-503	.05 Mfd ±10%, 400V DCW, Paper
C3-19	x	x	x	x	V3 Grid Coupling, LF	Phaser		
C3-20	x	x	x	x	V9 Grid Blocking	Near L6	A108719-503	.05 Mfd +30 −15%, 400V DCW, Paper
C4-1	x	x	x	x	V1 Cathode Bypass	TB2	A115156-503	.05 Mfd +30 −15%, 200V DCW, Paper
C4-2	x	x	x	x	V3 Cathode Bypass	TB2		
C4-3	x	x	x	x	V4 Cathode Bypass	TB2		
C4-4	x	x	x	x	V5 Cathode Bypass	TB2		
C4-5	x	x	x	x	V6 Cathode Bypass	TB2		
C4-6	x	x	x	x	V8 Cathode Bypass	TB2		
C4-7	x	x	x	x	V10 Cathode Bypass	TB2		
C4-8	x	x	x	x	V4 AVC Filter	Near Ant. Relay	A18181-503	.05 Mfd ±10%, 200V DCW, Paper
C4-9	x	x	x	x	V5 AVC Filter	Near Ant. Relay		
C4-10	x	x	x	x	V6 AVC Filter	Near RE2	A115156-503	.05 Mfd +30 −15%, 200V DCW, Paper
C4-11	x	x	x	x	V3 Cathode Filter	TB2		
C5-1	x	x	x	x	V12 Grid Bypass	TB2	A18181-203	0.1 Mfd ±10%, 200V DCW, Paper
C6-1	x	x	x	x	AVC Filter	TB2	A115156-203	.02 Mfd +30 −15%, 200V DCW, Paper
C6-2	x	x	x	x	V8 AVC Bypass	T13		
C7	x	x	x	x	V12 Grid Coupling	Near Hash Filter	E11398	0.5 Mfd ±10%, 400V DCW, Oil-Paper
C8	x	x	x	x	V11 Cathode Bypass	Near Hash Filter	E11402	5.0 Mfd +100% −0%, 50V DCW, Oil-Paper
C9-1	x	x	x	x	LV Filter Bypass	Hash Filter	E11400	2-section, each section 0.5 Mfd +20% −10%, 100V DCW, Oil-Paper
C9-2	x	x	x	x	LV Filter Bypass	Hash Filter		
C10-1	x	x	x	x	HV Filter		A15066	2-section, each section 6.0 Mfd +100% −10%, 400V DCW, Oil-filled
C10-2	x	x	x	x	HV Filter			
C11-1				x	V1 Grid Parallel Padder	Loop Can	A18207-350	35 Mmf ±10%, 500V DCW, Ceramic
C11-2	x			x	V5 Grid Parallel Padder	1st RF Can		
C11-3	x			x	V6 Grid Parallel Padder	2nd RF Can		
C11-4		x	x		V4 Grid Parallel Padder	Ant. Can		
C12-1	x	x	x	x	V10 RF Bypass	T14	A18182-7	50 Mmf ±2.5 Mmf, 500V DCW, Ceramicon
C12-2	x	x	x	x	V10 Grid Bypass	T14		

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					CAPACITORS—Continued			
C13	x	x	x	x	V10 RF Bypass	T14	A18205-101	100 Mmf ±10%, 500V DCW, Ceramic
C14-1	x	x	x	x	V4 Trap Resonator	L2, L3 (IF Trap)	C56310-502	5000 Mmf ±2%, 300V DCW, Mica
C14-2	x	x	x	x	V5 Trap Resonator			
C15	x	x	x	x	Ant. Coupling	Ant. Can	C56315-102	1000 Mmf ±10%, 500V DCW, Mica
C16	x	x	x	x	V11 Grid Coupling	TB1	C56312-103	.01 Mfd ±10%, 300V DCW, Mica
C17	x	x	x	x	V7 Grid Compensating	Osc. Can	C56315-250	25 Mmf ±10%, 500V DCW, Mica
C18-1		x		x	T9-1 Coupling	1st RF Can	A29857-100	10 Mmf ±10%, 500V DCW, Ceramic
C18-2		x		x	T9-2 Coupling	2nd RF Can		
C18-3				x	Trimmer Compensating	1st RF Can		
C18-4				x	Trimmer Compensating	2nd RF Can		
C19-1	x	x	x	x	V3 Grid RF Coupling	Phaser	C56314-251	250 Mmf ±5%, 500V DCW, Mica
C19-2	x	x	x	x	V3 Grid RF Coupling	Phaser		
C20-1	x			x	V4 Ant. Coupling	Ant. Can	A18205-100	10 Mmf ±10%, 500V DCW, Ceramic
C20-2	x	x	x	x	Trimmer Compensating	Osc. Can		
C20-3				x	Trimmer Compensating	Osc. Can		
C20-4		x			Trimmer Compensating	Ant. Can		
*C21-1	x			x	Ant. Compensating	Ant. Relay	C56314-101	100 Mmf ±5%, 500V DCW, Mica
C21-2	x				V4 Plate Resonator, Band 3	1st RF Can		
C21-3	x				V5 Plate Resonator, Band 3	2nd RF Can		
C21-4	x	x	x	x	V10 AVC Diode Coupling	T14		
C21-5	x	x	x	x	V9 Grid Coupling	Near L6		
C22-1	x			x	V4 Plate Resonator, Band 1	1st RF Can	C56314-301	300 Mmf ±10%, 500V DCW, Mica
C22-2	x			x	V5 Plate Resonator, Band 1	2nd RF Can		
C23-1	x			x	V4 Plate Resonator, Band 2	1st RF Can	C56314-750	75 Mmf ±5%, 500V DCW, Mica
C23-2	x			x	V5 Plate Resonator, Band 2	2nd RF Can		
C24-1	x		x		T9-1 Coupling	1st RF Can	A29857-050	5 Mmf ±10%, 500V DCW, Ceramic
C24-2	x		x		T9-2 Coupling	2nd RF Can		
**C24-3			x		V9 Grid Coupling	On V9 Socket		
C24-4				x	T6 Coupling	Ant. Can		
C25	x	x	x	x	V6 Injector Grid Coupling	Osc. Can	C56315-150	15 Mmf ±10%, 500V DCW, Mica
C26-3		x	x		V4 Ant. Coupling	Ant. Can	A18207-150	15 Mmf ±10%, 500V DCW, Ceramic
C28-1		x	x		V4 Plate Resonator, Band 1	1st RF Can	C56314-1750	175 Mmf ±5%, 500V DCW, Mica
C28-3		x	x		V5 Plate Resonator, Band 1	2nd RF Can		

* Used on later models in place of C43-1. ** C54 used in place of C24-3 in later models of Type MN-26W.

CTC. Sym.	Used on Radio Compass: MN-26A, C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					CAPACITORS—Continued			
C29	x			x	V4 Grid Parallel Padder	Ant. Can	A18207-250	25 Mmf ±10%, 500V DCW, Ceramic
C29-4		x	x		V6 Grid Parallel Padder	2nd RF Can	A25715-9	45 Mmf ±2%, 500V DCW, Ceramic
C30	x	x		x	V7 Series Padder, Band 1	Osc. Can	E12140-2	625 Mmf ±2%, 300V DCW, Mica
C31	x	x		x	V7 Series Padder, Band 2	Osc. Can	E12140-3	1286 Mmf ±2%, 300V DCW, Mica
C32	x				V7 Series Padder, Band 3	Osc. Can	E12140-4	2514 Mmf ±2%, 300V DCW, Mica
C33-3		x	x		V7 Grid Parallel Padder	Osc. Can	A18207-400	40 Mmf ±10%, 500V DCW, Ceramic
C34-1	x	x	x	x	V6 Plate Resonator	T13		
C34-2	x	x	x	x	V8 Grid Resonator	T13		500 Mmf ±2%, 500V DCW, Mica
C34-3	x	x	x	x	V8 Plate Resonator	T14	C56313-501	
C34-4	x	x	x	x	V10 Diode Resonator	T14		
C34-5	x	x	x	x	V9 Grid Resonator	Near L6		
C35	x	x	x	x	V10 Plate Bypass	TB1	C56315-501	500 Mmf ±10%, 500V DCW, Mica
C37-1					LV Dyn., RF Filter			3-section, each section
C37-2	x	x	x	x	HV Dyn., RF Filter	Hash Filter	E11347-1	0.1 Mfd ±10%, 400V
C37-3					HV Dyn., RF Filter			DCW, Paper
C38	x	x	x	x	V1 Plate Resonator	Phaser	C56313-101	100 Mmf ±2%, 500V DCW, Mica
C39-1	x	x	x	x	V2 Plate #1 Bypass	TB2		0.1 Mfd ±10%, 400V DCW, Paper
C39-2	x	x	x	x	V2 Plate #2 Bypass	TB2	A18015-104	
C39-5	x	x	x	x	V12 Screen Bypass	TB2		
C40-1	x				V7 Grid Parallel Padder	Osc. Can	A18207-300	30 Mmf ±10%, 500V DCW, Ceramic
C40-2	x				V1 Grid Parallel Padder	Loop Can		
C41-1			x		V4 Plate Resonator, Band 3	1st RF Can	C56314-450	45 Mmf ±5%, 500V DCW, Mica
C41-2			x		V5 Plate Resonator, Band 3	2nd RF Can		
C42		x		x	V7 Series Padder, Band 3	Osc. Can	E12140-11	6900 Mmf ±2%, 300V DCW, Mica
*C43-1		x	x		Ant. Compensating	Ant. Relay		50 Mmf ±2%, 500V DCW, Mica
C43-2		x	x		V4 Plate Resonator, Band 2	1st RF Can	C56314-500	
C43-3		x	x		V5 Plate Resonator, Band 2	2nd RF Can		
C48			x		V7 Series Padder, Band 1	Osc. Can	E12140-8	815 Mmf ±2%, 300V DCW, Mica

* In later models of Type MN-26W, C21-1 is used in place of C43-1.

CTC. Sym.	Used on Radio Compass MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					CAPACITORS—Concluded			
C49			x		V7 Series Padder, Band 2	Osc. Can	E12140-9	1625 Mmf ±2%, 300V DCW, Mica
C50			x		V7 Series Padder, Band 3	Osc. Can	E12140-10	2820 Mmf ±2%, 300V DCW, Mica
C53-1		x	x		V5 Grid Parallel Padder	1st RF Can	A25715-9	45 Mmf ±2%, 500V DCW, Ceramic
C54	x	x		x	V9 Grid Coupling	Above V9 Socket	A18182-2	5 Mmf ±0.5 Mmf, 500V DCW, Ceramicon
C55				x	Trimmer Compensating	Ant. Can	A18207-150	15 Mmf ±10%, 500V DCW, Ceramic
C56	x	x	x	x	V12 Grid Resonator	T16	A18014-104	0.1 Mfd ±5%, 200V DCW, Paper
C57		x	x		V1 Grid Parallel Padder	Loop Can	A18207-300	30 Mmf ±10%, 500V DCW, Ceramic
C58		x			V1 Grid Parallel Padder	Loop Can	A18207-450	45 Mmf ±10%, 500V DCW, Ceramic
					DYNAMOTORS			
DYN	*		*		Dynamotor		C56728-7	28V 1.6A Input, Special
DYN	*	x	*	x	Dynamotor		C56728-2	28V 1.6A Input
DYN	*				Dynamotor		C56728-1	14V 3.3A Input
DYN	x			x	Dynamotor		L74764	28V 1.6A Input
	**	**	**	**	LV+ Brush			
	**	**	**	**	LV− Brush			
	**	**	**	**	HV+ Brush		**	
	**	**	**	**	HV− Brush			
	**	**	**	**	Bearings			
	**	**	**	**	Armature			
					RECEPTACLES			
J4	x	x	x	x	Receptacle for P4	Front Panel	A30094	23-contact
J7	x	x	x	x	Receptacle for P7	Front Panel	A30084	6-contact
J10	x	x	x	x	Receptacle for P10	Front Panel	B7380-1	1-contact
					INDUCTORS			
L1	x	x	x	x	Loop Phase	Phaser	AL71791-16	1-coil, sealed, 85Ω 670 turns #39SSE
L2	x	x	x	x	IF Trap	L2, L3 (IF Trap)	AE11635-1	425μH ±1%, 95⅞ turns #30/44 Litz, Sealed
L3	x	x	x	x	IF Trap	L2, L3 (IF Trap)	AE11634-1	Same as L2

* Bendix Part Number of Dynamotor for MN-26A or MN-26W is C56728-1 and
Bendix Part Number of Dynamotor for MN-26C or MN-26X is C56728-2 and
Bendix Part Number of Dynamotor for MN-26CA is C56728-7.

** Submit nameplate data when ordering replacement parts of motors or dynamotors.

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					INDUCTORS—Continued			
L6	x	x	x	x	BFO Coil Assembly		AL71791-17	1-coil, Sealed, Tapped
L7-1	x	x	x	x	LV RF Choke	Hash Filter	AB6859-1	45 turns #185SE
L7-2	x	x	x	x	LV RF Choke	Hash Filter		
L8	x	x	x	x	HV RF Choke	Hash Filter	AB6859-2	40Ω
L9-1	x	x	x	x	V11 Filter Choke	T15	Part of T15	6H, 50MA, 340Ω
L9-2	x	x	x	x	HV Filter Choke	T16	Part of T16	Same as L9-1
L10	x	x	x	x	V6 Plate	T13	AA26868-1	410 Turns #15/44 SS Litz
L11	x	x	x	x	V6 Grid	T13	AA26867-1	Same as L10
L12	x	x	x	x	V8 Plate	T14	AA26868-1	Same as L10
L13	x	x	x	x	V10 Audio Diode	T14	AA26869-1	Same as L10
					MOTORS			
MO	***	x	MO	x	Band Switch Motor		E11500-1	24-28V DC 1.25A No Load
MO	***		x		Band Switch Motor		E11500-2	12-14V DC 2.5A No Load
MO-5-C	x			x	Band Switch Motor		C58519	24-28V, 1.25A No Load
	**	**	**	**	+Brush −Brush Bearing, Shaft End Bearing, Commutator End Armature, 14V Armature, 28V			
					NEON TUBES			
NE1	x	x	x	x	Overload Discharge	Loop Can	QB15347	1/25W, 60V AC, unbased
NE2	x	x	x	x	Overload Discharge	Ant. Can		
					PLUGS			
P4	x	x		x	Compass to Junction Box	J4	A30095	23-contact
P4			x		Compass to Junction Box	J4	A30601	
P10	x	x	x	x	Antenna Lead-in	J10	B7380-2	1-contact
					RESISTORS			
R1	x	x	x	x	Loop Gain Control	Side of Chassis	QB15353	Potentiometer, 15000Ω, Curve D
R2-1		x	x		V5 RF Compensator, Band 1	1st RF Can	A16428-6	25Ω, 1/2W, Wire Wound
R2-2		x	x		V6 RF Compensator, Band 1	2nd RF Can		

*** Bendix Part Number of Motor for MN-26A or MN-26W is E11500-2 and
Bendix Part Number of Motor for MN-26C, MN-26X or MN-26CA is E11500-1.

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					RESISTORS—Continued			
R7	x	x	x	x	V1 Cathode Bias	TB1	A18151-301	300Ω ±10%, 1/4W, Ceramic
R9-1	x		x		V1 RF Compensator, Band 3	Loop Can	A16428-3	3Ω, 1/2W, Wire Wound
R9-2	x		x		V5 RF Compensator, Band 3	1st RF Can		
R9-3	x		x		V6 RF Compensator, Band 3	2nd RF Can		
R10-1	x	x	x	x	V5 RF Compensator, Band 2	1st RF Can	A16428-2	10Ω, 1/2W, Wire Wound
R10-2	x	x	x	x	V6 RF Compensator, Band 2	2nd RF Can		
R11-1	x			x	V5 RF Compensator, Band 1	1st RF Can	A16428-4	20Ω, 1/2W, Wire Wound
R11-2	x			x	V6 RF Compensator, Band 1	2nd RF Can		
*R12-1			x		Loop AVC Bypass		A18151-104	100,000Ω ±10%, 1/4W, Ceramic
R12-2	x	x	x	x	V4 Screen Voltage Dropping	TB2		
R12-3	x	x	x	x	V5 Screen Voltage Dropping	TB1		
R12-4	x	x	x	x	V10 Grid	T14		
R12-5	x	x	x	x	V8 AVC Filter	T13		
R12-6	x	x	x	x	V3 Audio Voltage Supply	Phaser		
R12-7	x	x	x	x	V3 Audio Voltage Supply	Phaser		
R12-9	x	x	x	x	Sidetone Filter	Near RE2		
R12-10	x	x	x	x	V2 Audio Voltage Filter	TB1		
R12-11	x	x	x	x	V2 Audio Voltage Filter	TB1		
R12-12	x	x	x	x	V3 Cathode Bias	TB1		
R12-13	x	x	x	x	V3 Plate Dropping	TB2		
R12-14	x	x	x	x	V9 Grid Leak	Near L6		
R12-15	x	x	x	x	V9 Plate Voltage Dropping	TB1		
R13-1	x	x	x	x	V6 Screen Voltage Bleeder	TB1	A18151-154	150,000Ω ±10%, 1/4W, Ceramic
R13-2	x	x	x	x	V12 Screen Voltage Dropping	TB1		
R14-1	x	x	x	x	V2 Grid Leak	TB1	A18151-503	50,000Ω ±10%, 1/4W, Ceramic
R14-2	x	x	x	x	V2 Grid Leak	TB1		
R14-3	x	x	x	x	V6 Injector Grid Leak	Osc. Can		
R14-4	x	x	x	x	V7 Grid Leak	Osc. Can		
R14-5	x	x	x	x	V10 RF Filter	T14		
R14-6	x	x	x	x	V3 Cathode Bias	TB1		
R14-7	x	x	x	x	V4 AVC Filter	Near Ant. Relay		
R14-8	x	x	x	x	V5 AVC Filter	Near Ant. Relay		
R14-9	x	x	x	x	V6 AVC Filter	Near RE2		
R14-10	x	x	x	x	V8 Screen Voltage Dropping	TB1		
R14-11	x	x	x	x	V7 Plate Voltage Dropping	TB2		
R14-12	x	x	x	x	V9 Grid Return	TB1		
R14-13	x	x	x	x	V1 Screen Voltage Dropping	TB1		
R15-1	x	x	x	x	V2 Plate Load	TB1	A18151-202	2000Ω ±10%, 1/4W, Ceramic
R15-2	x	x	x	x	V2 Plate Load	TB1		
R18-1	x	x	x	x	Ant. Static Leak	Ant. Relay	A18151-105	1 megohm ±10%, 1/4W, Ceramic
R18-4	x	x	x	x	AVC Filter	T14		
R19-1	x	x	x	x	V12 Grid	TB1	A18151-102	1000Ω ±10%, 1/4W, Ceramic
R19-2	x	x	x	x	V1 Plate Voltage Dropping	TB1		

* Not used in later models of Type MN-26W.

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
RESISTORS—Continued								
R20-1	x	x	x	x	V8 Plate Voltage Dropping	TB1	A18151-502	5000Ω ±10%, 1/4W, Ceramic
R20-2	x	x	x	x	V4 Plate Voltage Dropping	TB2		
R20-3	x	x	x	x	V5 Plate Voltage Dropping	TB2		
R20-4	x	x	x	x	V6 Plate Voltage Dropping	TB1		
R21	x	x	x	x	V3 Cathode Bleeder	TB1	A18151-204	200,000Ω ±10%, 1/4W, Ceramic
R22-1	x	x	x	x	V3 Grid Load	TB1	A18151-504	500,000Ω ±10%, 1/4W, Ceramic
R22-2	x	x	x	x	V3 Grid Load	Above V3 Socket		
R22-3	x	x	x	x	V12 Grid			
R22-4	x	x	x	x	V10 AVC Diode Load	T14		
R22-5	x	x	x	x	V11 Grid	TB1		
R23	x	x	x	x	V3 Cathode Bias	TB1	A18151-103	10,000Ω ±10%, 1/4W, Ceramic
R24-1	x	x	x	x	V4 Cathode Bias	TB1	A18151-601	600Ω ±10%, 1/4W, Ceramic
R24-2	x	x	x	x	V5 Cathode Bias	TB1		
R24-3	x	x	x	x	V6 Cathode Bias	TB1		
R24-4	x	x	x	x	V8 Cathode Bias	TB1		
R24-5	x	x	x	x	V12 Cathode Bias	TB1		
R27	x	x	x	x	V2 Cathode Bias	TB1	A18151-101	100Ω ±10%, 1/4W, Ceramic
R28	x	x	x	x	V10 Grid Load	T14	A18151-254	250,000Ω ±10%, 1/4W, Ceramic
R29	x	x	x	x	V11 Cathode Bias	Across C8 Terminals	A18150-501	500Ω ±10%, 1/2W, Ceramic
R31	x	x	x	x	V10 Cathode Bias	TB1	A18151-302	3000Ω ±10%, 1/4W, Ceramic
R32	x	x	x	x	V12 Grid Isolating	TB1	A18151-304	300,000Ω ±10%, 1/4W, Ceramic
R35-1	x	x	x	x	Azimuth Dial Light Dropping	Near Hash Filter	1st Preference A14739	117Ω Total, Section A 50Ω, Section B 67Ω, Wire Wound, Metal Case
							2nd Preference A110729-1	117Ω Total, Section A 50Ω, Section B 67Ω, Wire Wound, Phenolic Case
R36	x	x	x	x	Ant. Relay Voltage Dropping	Near Hash Filter	1st Preference A30031	195Ω Total, Section A 120Ω, Section B 75Ω, Wire Wound, Metal Case
							2nd Preference A110729-3	195Ω Total, Section A 120Ω, Section B 75Ω, Wire Wound, Phenolic Case

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					RESISTORS—Continued			
R37-1	x	x	x	x	Fil. Current Compensating	Near V2 & V12 Sockets	1st Preference A15273	75.6Ω Total, Section A 12.6Ω, Section B 63Ω, Wire Wound, Metal Case
R37-2	x	x	x	x	Sidetone Relay Dropping	Near Hash Filter	2nd Preference A110729-2	75.6Ω Total, Section A 12.6Ω, Section B 63Ω, Wire Wound, Phenolic Case
R38	x	x	x	x	V10 Plate Voltage Dropping	TB1	A18151-253	25,000Ω ±10%, 1/4W, Ceramic
R39	x	x	x	x	V6 Screen Voltage Dropping	TB2	A18150-253	25,000Ω ±10%, 1/2W, Ceramic
					RELAYS			
RE1	x	x	x	x	Antenna	Ant. Relay	QB7856	DPDT, 8-16V
RE2	x	x	x	x	Sidetone			
	x	x	x	x	Audio Cutout	Band Switch	A114293	320Ω
					SWITCHES			
S1-1	x	x	x	x	Loop Band Selector, Pri.	Loop Can	QB9589-2	Bakelite Wafer Switch
S1-2	x	x	x	x	Ant. Band Selector, Pri. 1	Ant. Can		
S1-3	x	x	x	x	1st RF Band Selector, Pri. Sec.	1st RF Can		
S1-4	x	x	x	x	2nd RF Band Selector, Pri. Sec.	2nd RF Can		
S2	x	x	x	x	Loop Band Selector, Sec.	Loop Can	QB9589-1	Bakelite Wafer Switch
S3	x	x	x	x	Ant. Band Selector, Pri. Sec.	Ant. Can	QB9589-4	Bakelite Wafer Switch
S4	x	x	x	x	HF Osc. Band Selector	Osc. Can	QB9589-3	Bakelite Wafer Switch
S5	x	x	x	x	Motor Positioning	Band Switch	QB9589-5	Bakelite Wafer Switch
S6	x	x	x	x	Motor Control	Band Switch	E10355 or C57496	1 make and 2 break, Non-locking
					TRANSFORMERS			
T1	x				Loop Band 1	Loop Can	AL71791-1	2 coils, Sealed
T1		x					AL72150-27	
T1			x				AL72150-31	
T1				x			AL72150-34	
T2	x				Loop Band 2	Loop Can	AL71791-2	2 coils, Sealed
T2		x					AL72150-28	
T2			x				AL72150-32	
T2				x			AL72150-35	
T3	x				Loop Band 3	Loop Can	AL71791-3	2 coils, Sealed
T3			x				AL72150-33	

CTC. Sym.	*Used on Radio Compass*				*Function of Part*	*Location of Part (Part of)*	*Bendix Part Number*	*Description*
	MN-26A C or CA	*MN-26M*	*MN-26X, MN-26W*	*MN-26Y*				
					TRANSFORMERS—Continued			
T4	x			x	Ant. Band 1	Ant. Can	AL71791-13	3 coils, Sealed
T4		x	x				AL72150-18	
T5	x			x	Ant. Band 2	Ant. Can	AL71791-14	3 coils, Sealed
T5		x	x				AL72150-19	
T6	x				Ant. Band 3	Ant. Can	AL71791-15	3 coils, Sealed
T6		x		x			AL72150-9	
T6			x				AL72150-20	
T7-1	x			x	1st RF Band 1	1st RF Can	AL71791-7	2 coils, Sealed
T7-1		x	x				AL72150-6	
T7-2	x			x	2nd RF Band 1	2nd RF Can	AL71791-7	
T7-2		x	x				AL72150-6	
T8-1	x			x	1st RF Band 2	1st RF Can	AL71791-8	2 coils, Sealed
T8-1		x	x				AL72150-22	
T8-2	x			x	2nd RF Band 2	2nd RF Can	AL71791-8	
T8-2		x	x				AL72150-22	
T9-1	x				1st RF Band 3	1st RF Can	AL71791-9	2 coils, Sealed
T9-1		x		x			AL72150-10	
T9-1			x				AL72150-23	
T9-2	x				2nd RF Band 3	2nd RF Can	AL71791-9	
T9-2		x		x			AL72150-10	
T9-2			x				AL72150-23	
T10	x			x	HF Osc. Band 1	Osc. Can	AL71791-4	2 coils, Sealed
T10		x	x				AL72150-24	
T11	x			x	HF Osc. Band 2	Osc. Can	AL71791-5	2 coils, Sealed
T11		x	x				AL72150-25	
T12	x				HF Osc. Band 3	Osc. Can	AL71791-6	2 coils, Sealed
T12		x		x			AL72150-11	
T12			x				AL72150-26	
T13	x	x	x	x	1st IF Transformer		AL71798-1	Contains; L10, L11, C6-2, C3-12, C34-1, C34-2, R12-5
T14	x	x	x	x	2nd IF Transformer		AL71908-1	Contains; C3-10, C12-1, C12-2, C13, C21-4, C34-3, C34-4, L12, L13, R12-4, R12-8, R14-5, R22-4
T15	x	x	x	x	Audio Output		A14987	Contains; T15, L9-1
T16	x	x	x	x	Compass Output		A15064	Contains; T16, L9-2, C5-2

CTC. Sym.	Used on Radio Compass: MN-26A C or CA	MN-26M	MN-26X, MN-26W	MN-26Y	Function of Part	Location of Part (Part of)	Bendix Part Number	Description
					VACUUM TUBES			
V1	x	x	x	x	Loop Amplifier		Type 6K7	Triple-Grid Super-Control Amp.
V2	x	x	x	x	Audio Oscillator		Type 6N7	Class B Twin Amplifier
V3	x	x	x	x	Modulator		Type 6N7	Class B Twin Amplifier
V4	x	x	x	x	1st RF Amp.		Type 6K7	Triple-Grid Super-Control Amp.
V5	x	x	x	x	2nd RF Amp.		Type 6K7	Triple-Grid Super-Control Amp.
V6	x	x	x	x	1st Detector		Type 6L7	Pentagrid Mixer Amplifier
V7	x	x	x	x	HF Oscillator		Type 6J5	Detector Amplifier Triode
V8	x	x	x	x	IF Amp.		Type 6K7	Triple-Grid Super-Control Amp.
V9	x	x	x	x	CW Oscillator		Type 6J5	Detector Amplifier Triode
V10	x	x	x	x	2nd Det. and 1st Audio		Type 6B8	Duplex-Diode Pentode
V11	x	x	x	x	Audio Output		Type 6F6	Power Amplifier Pentode
V12	x	x	x	x	Compass Output		Type 6K7	Triple-Grid Super-Control Amp.

b. TYPE MN-28 REMOTE CONTROL SERIES

CTC. Sym.	Used on Type No.: MN-28 A, C, NA and Y	MN-28 G	MN-28 X	Function of Part	Bendix Part Number	Description
				FUSE		
FU1	x	x	x	Overload Protection	A11302-28	10A, 25V
				JACKS AND RECEPTACLE		
J1	x	x	x	Phone Jack	A28960	1-circuit
J1				Phone Jack	A26837	Same as above
J3	x	x	x	Receptacle for P3	A30089	16-contact Wall Mtg. Receptacle

CTC. Sym.	Used on Type No. MN-28 A, C, NA and Y	MN-28 G	MN-28 X	Function of Part	Bendix Part Number	Description
				LAMP		
LM-1	x	x	x	Dial Illumination	A18881-1	3V 0.19A
				PLUG		
P3	x	x	x	For Cable from Junction Box to Remote Control Unit	A30852 or A100144	16-contact, Straight 16-contact, Right Angle
				RESISTORS		
R2 R3	x	x	x	Threshold Sens. Control COMPASS Control	A14551	2-section potentiometer, Separate Shafts, (R2) 50,000Ω, (R3) 2000Ω
R4A R4B	x		x	AUDIO Control	L72704	Dual Potentiometer, (R4A) 2000Ω, (R4B) 25,000Ω
R4A R4B		x		AUDIO Control	A14550	Dual Potentiometer, (R4A) 25,000Ω (R4B) 25,000Ω
R6	x	x	x	LIGHT Control	A14549	Rheostat, 100Ω, Wire Wound, Taper A
R35-3	x	x	x	Panel Light Voltage Dropping	A14739	117Ω Total, Sect. A 50Ω, Sect. B 67Ω
R42	x				A18150-251	250Ω ±10%, 1/2W
				SWITCHES		
S8	x	x	x	Function Selector	A14657	Special
S9	x			Band Selector	A100798	1-pole 3-throw
S9		x	x	Band Selector	B6707	1-pole 3-throw
S10	x	x	x	CW ON-OFF Switch	A26947-1	S.P.S.T., 3A, 250V

c. TYPE MN-52G AND TYPE MN-52J AZIMUTH CONTROL

Quantity	*Symbol*	*Description*	*Function of Part*	*Bendix No.*
1	LM-2	LAMP 3v, 0.19 A	Dial Light	A18881-1
1	PA	PLUGS Single Cont. female 6 cont. Female	Power Cable Connection	A108002 BA30088
1 1	RB	RECEPTACLES For PA Plug 6 Cont. Wall Mtg. Type	Power Cable Connection	A108000 BA30084
1 or 2	S-11	SWITCHES SPST Toggle	Dial light or off-zero light	B418-1
1		CLAMP Shielded Cable Clamp		C59652-3

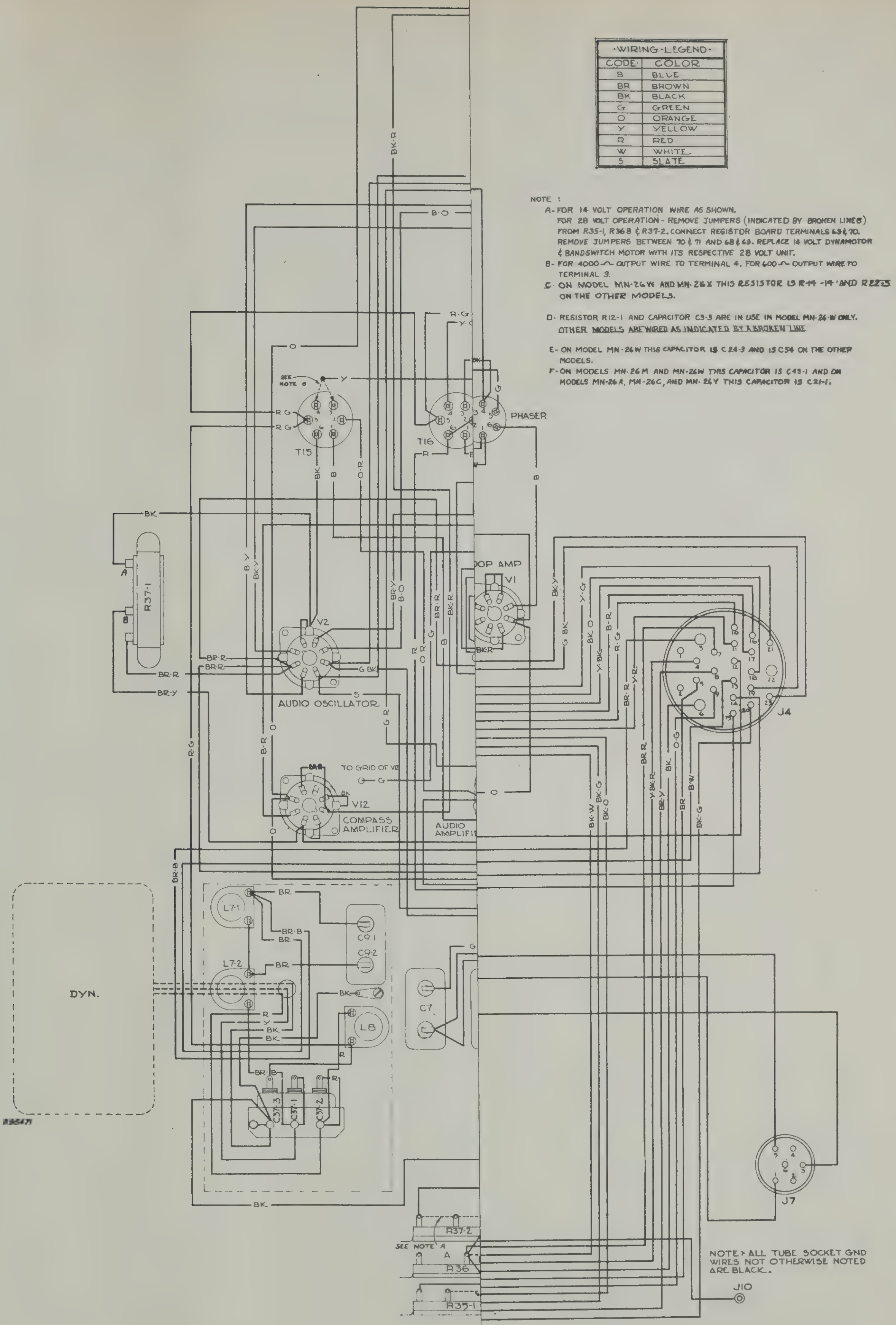
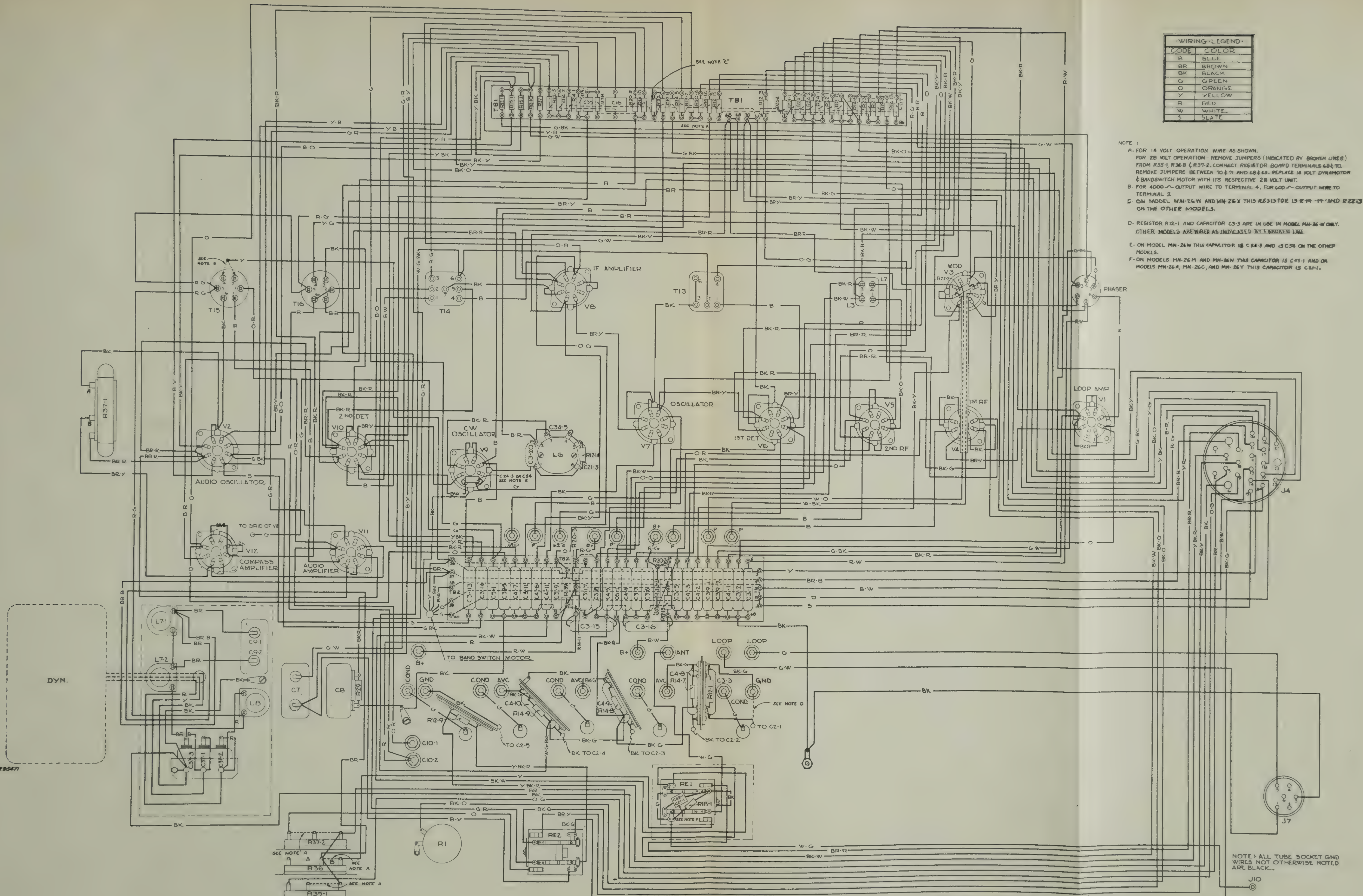


FIGURE 73 — TYPE MN-26 RADIO COMPASS, WIRING DIAGRAM



WIRING LEGEND	
CODE	COLOR
B	BLUE
BR	BROWN
BK	BLACK
G	GREEN
O	ORANGE
Y	YELLOW
R	RED
W	WHITE
S	SLATE

NOTE :

A- FOR 14 VOLT OPERATION WIRE AS SHOWN.
FOR 28 VOLT OPERATION - REMOVE JUMPERS (INDICATED BY BROKEN LINES) FROM R35-1, R36B & R37-2. CONNECT RESISTOR BOARD TERMINALS 69 & 70. REMOVE JUMPERS BETWEEN 70 & 71 AND 68 & 69. REPLACE 14 VOLT DYNAMOTOR & BANDSWITCH MOTOR WITH ITS RESPECTIVE 28 VOLT UNIT.

B- FOR 4000 ∿ OUTPUT WIRE TO TERMINAL 4. FOR 600 ∿ OUTPUT WIRE TO TERMINAL 3.

C- ON MODEL MN-26W AND MN-26X THIS RESISTOR IS R-14-14 AND R22-3 ON THE OTHER MODELS.

D- RESISTOR R12-1 AND CAPACITOR C3-3 ARE IN USE IN MODEL MN-26-W ONLY. OTHER MODELS ARE WIRED AS INDICATED BY A BROKEN LINE.

E- ON MODEL MN-26W THIS CAPACITOR IS C24-3 AND IS C54 ON THE OTHER MODELS.

F- ON MODELS MN-26M AND MN-26W THIS CAPACITOR IS C43-1 AND ON MODELS MN-26A, MN-26C, AND MN-26Y THIS CAPACITOR IS C21-1.

NOTE: ALL TUBE SOCKET GND WIRES NOT OTHERWISE NOTED ARE BLACK.

FIGURE 73 — TYPE MN-26 RADIO COMPASS, WIRING DIAGRAM

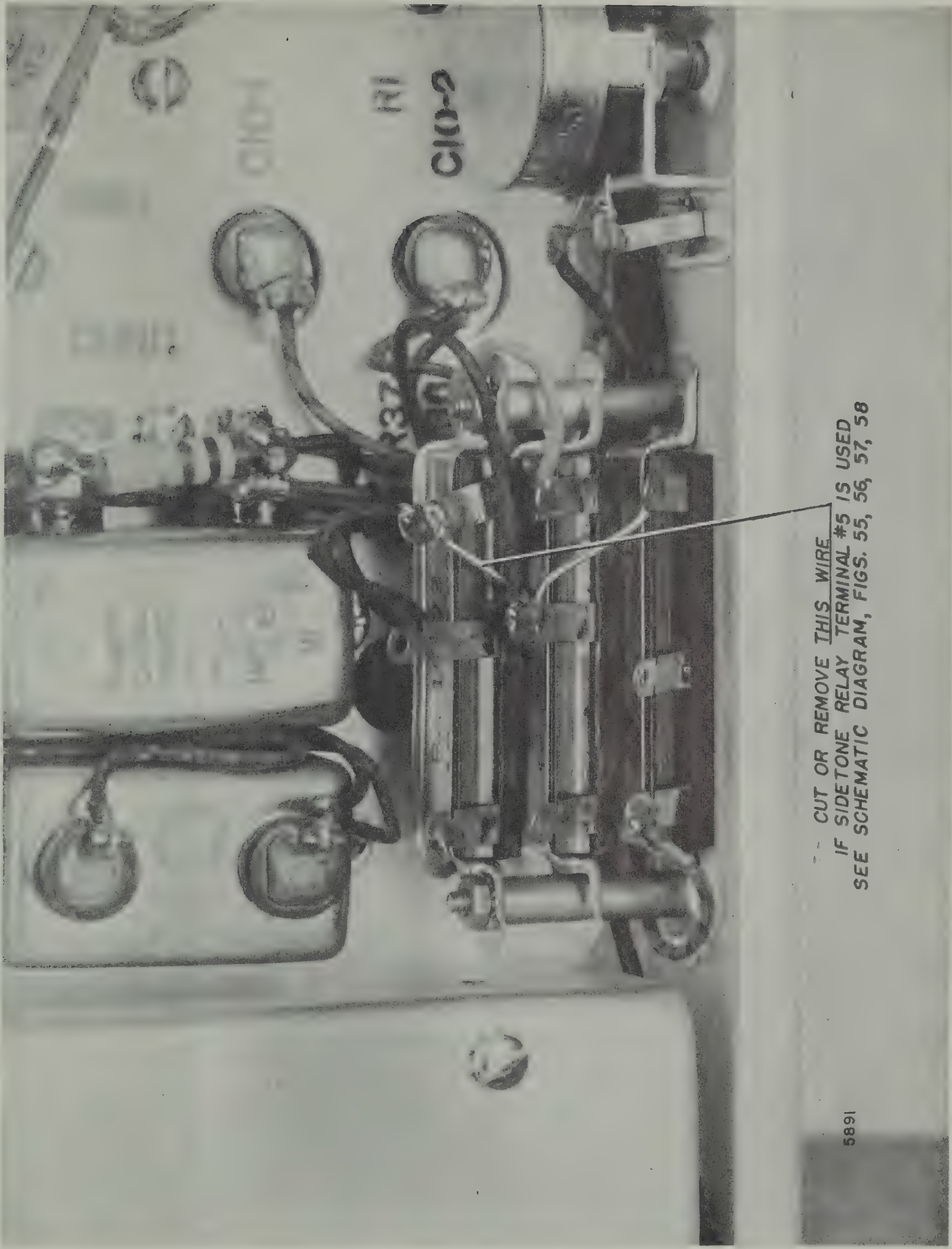


FIGURE 74 — CIRCUIT CHANGE NECESSARY WHEN USING SIDETONE RELAY TERMINAL #5

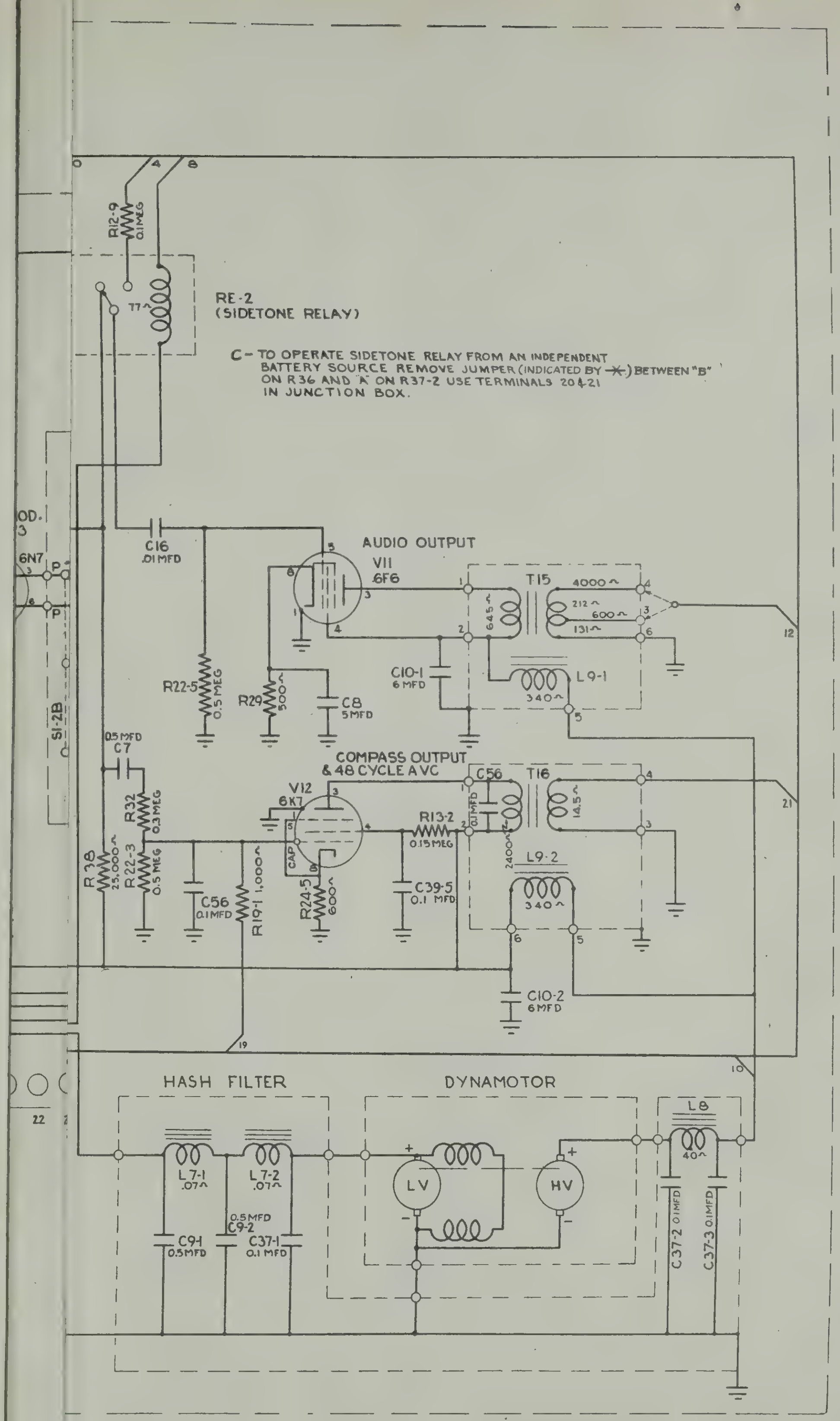
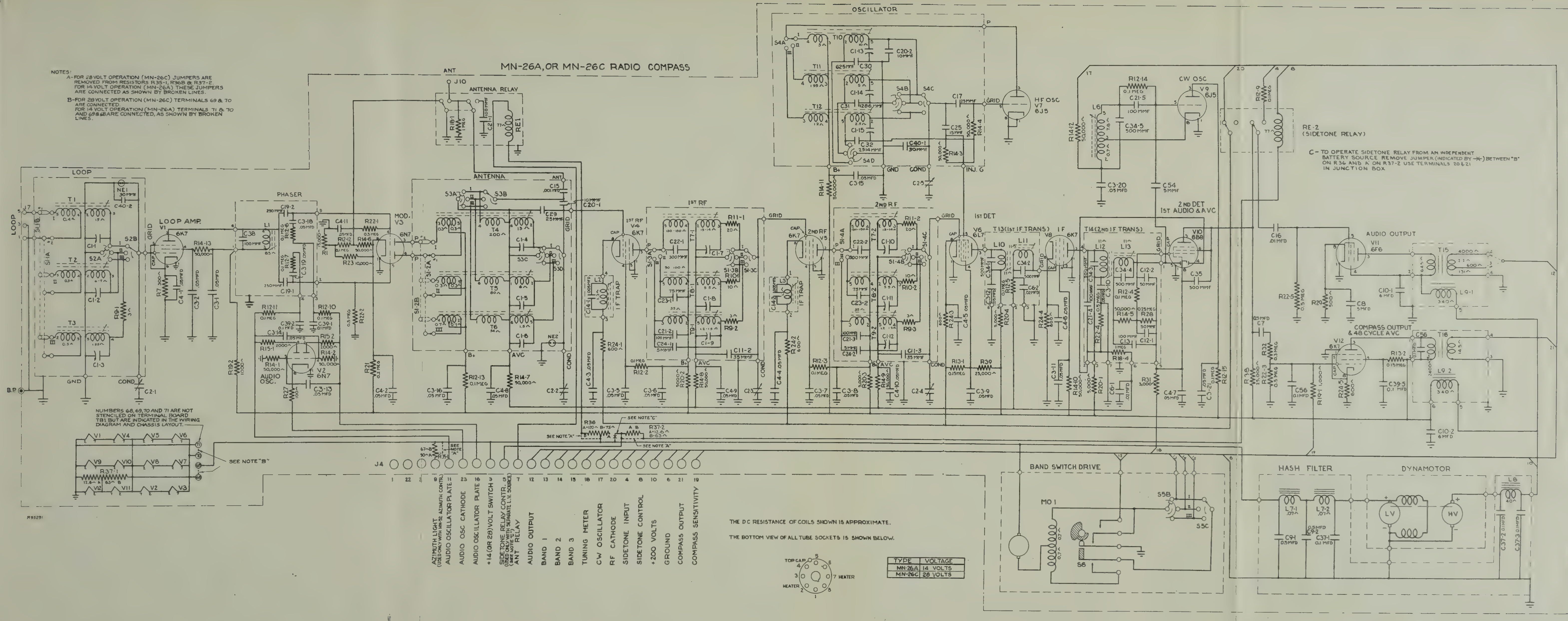


FIGURE 75 — TYPES MN-26A, MN-26C AND MN-26CA RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM



TYPE	VOLTAGE
MN-26A	14 VOLTS
MN-26C	28 VOLTS

Figure 75 — Types MN-26A, MN-26C and MN-26CA Radio Compass, Schematic Circuit Diagram

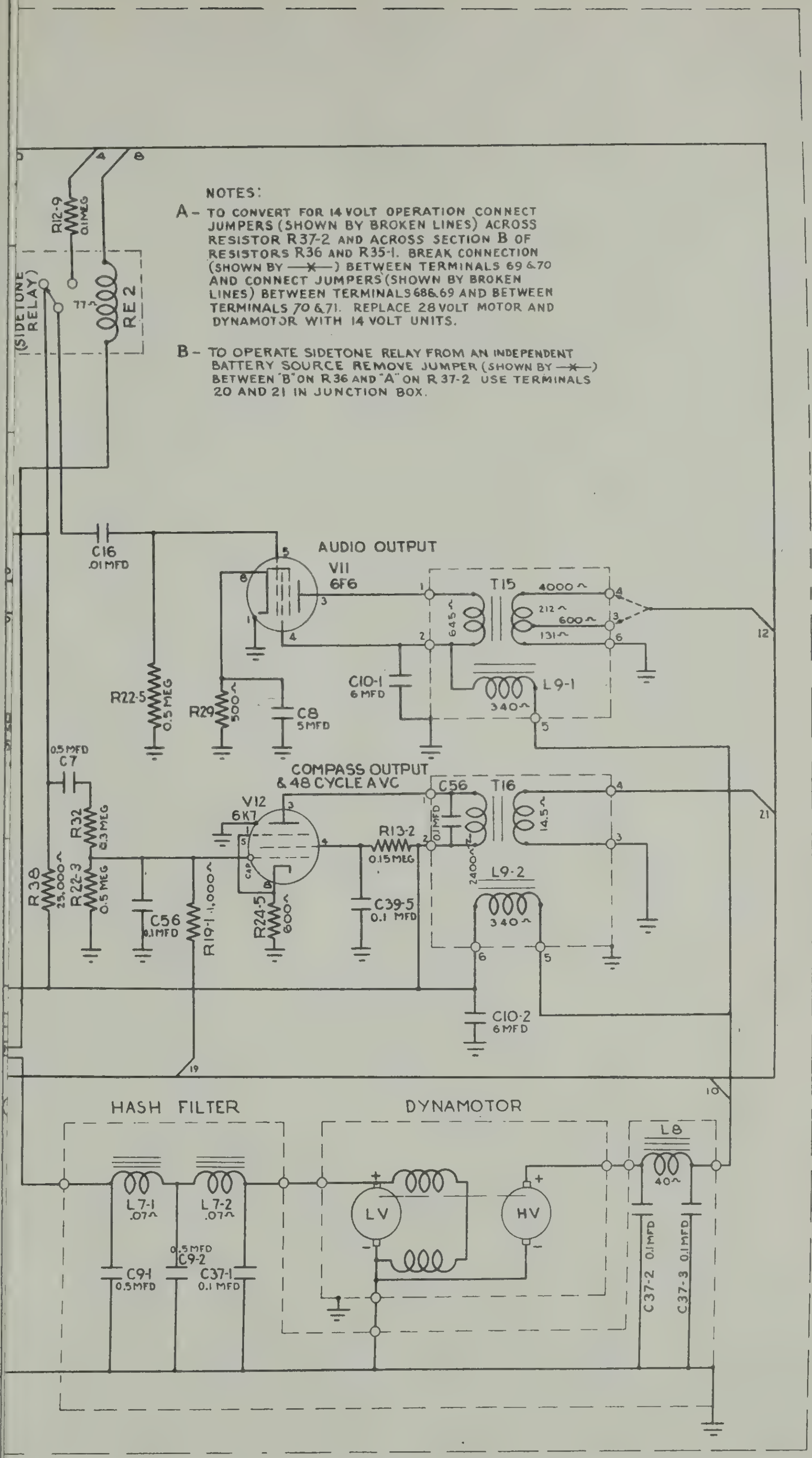


Figure 76 — Type MN-26M Radio Compass, Schematic Circuit Diagram

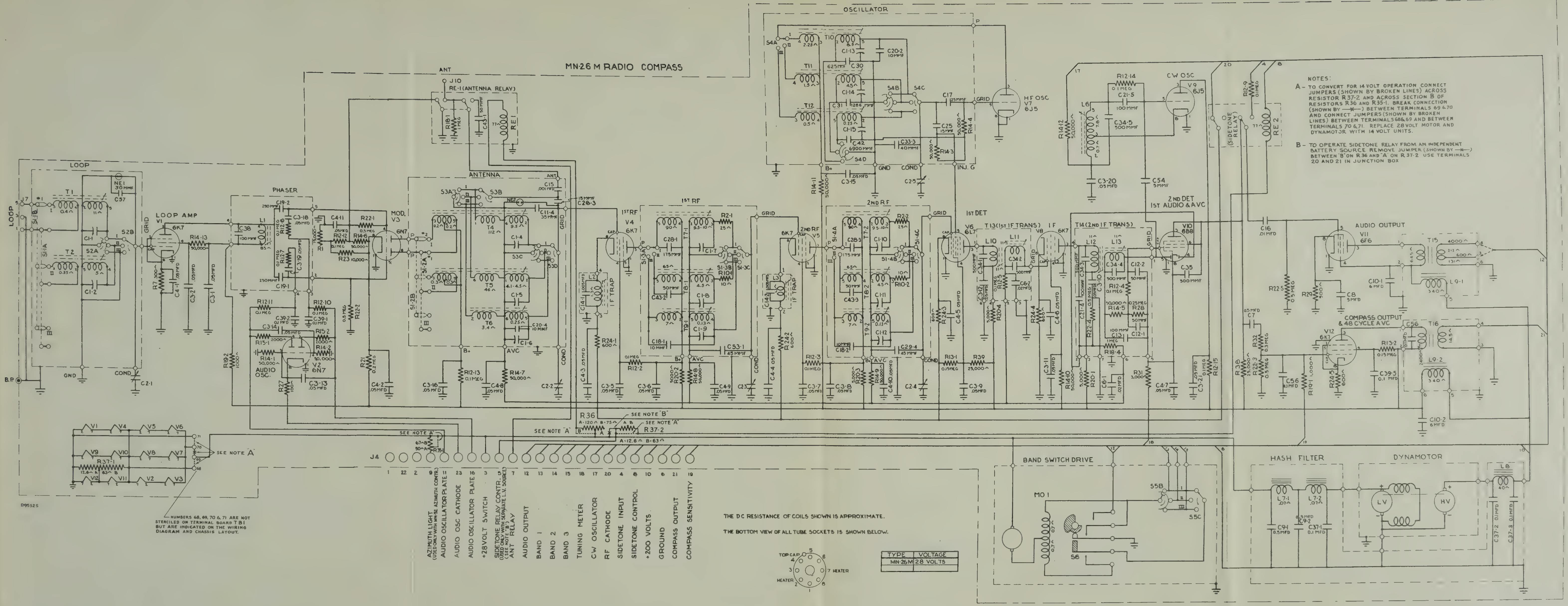


FIGURE 76 — TYPE MN-26M RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

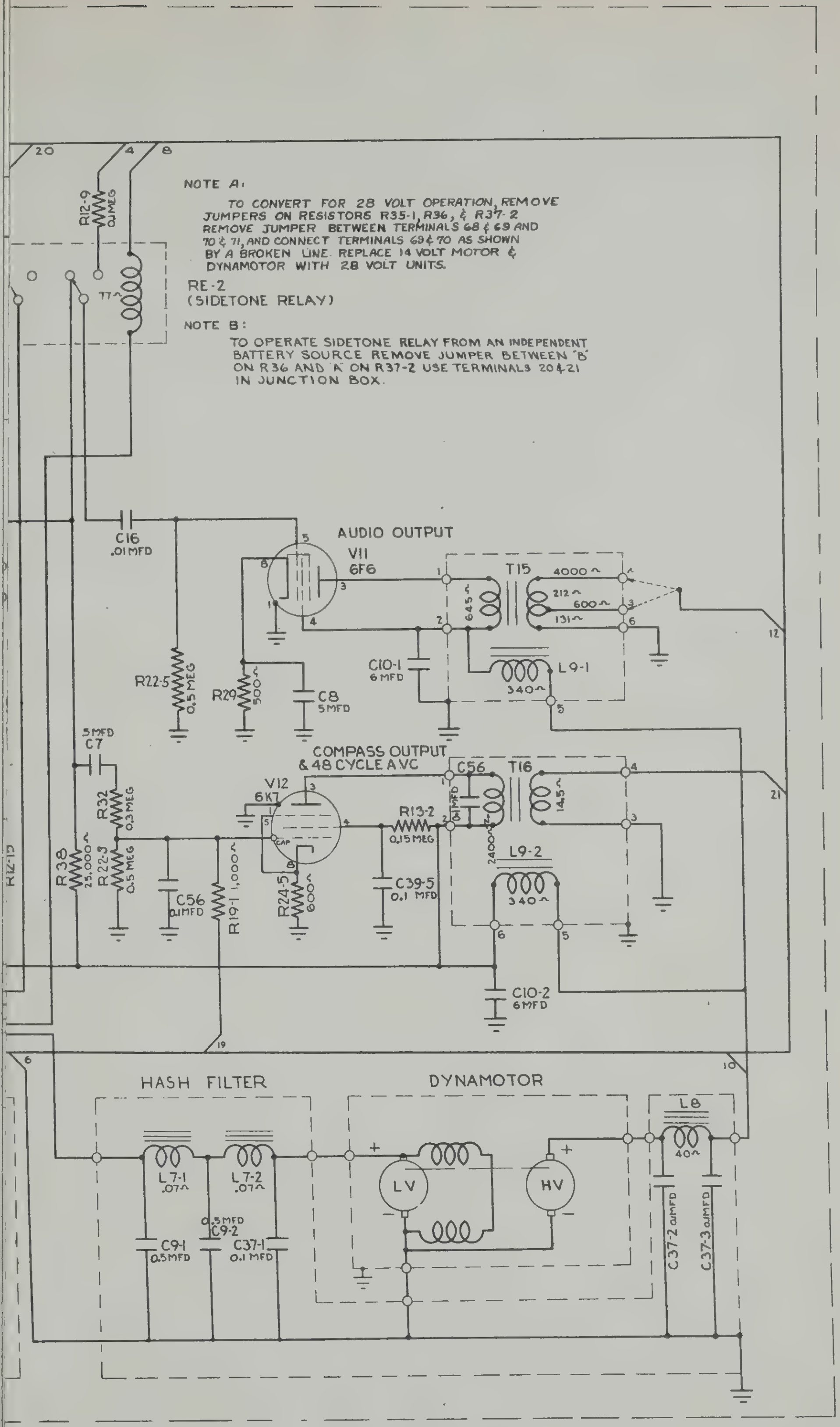


Figure 77 — Types MN-26W, and MN-26X
Radio Compass, Schematic Circuit Diagram

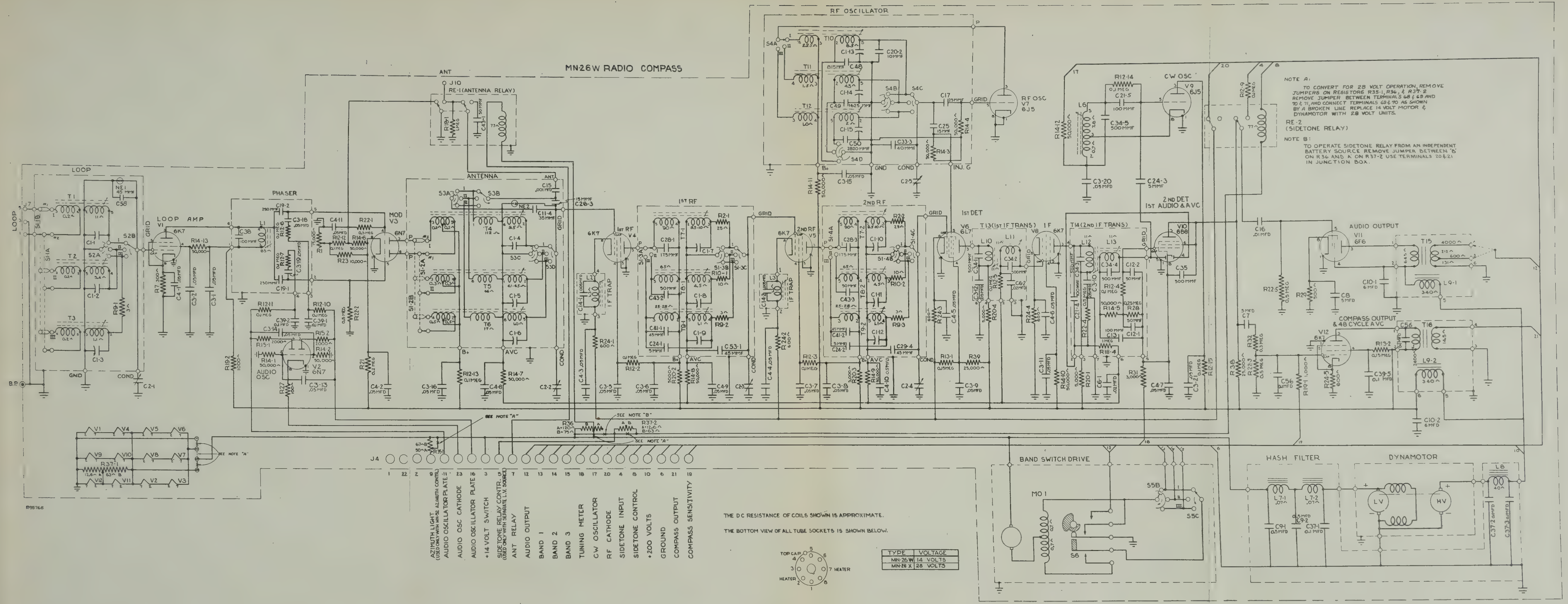


FIGURE 77 — TYPES MN-26W, AND MN-26X RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM

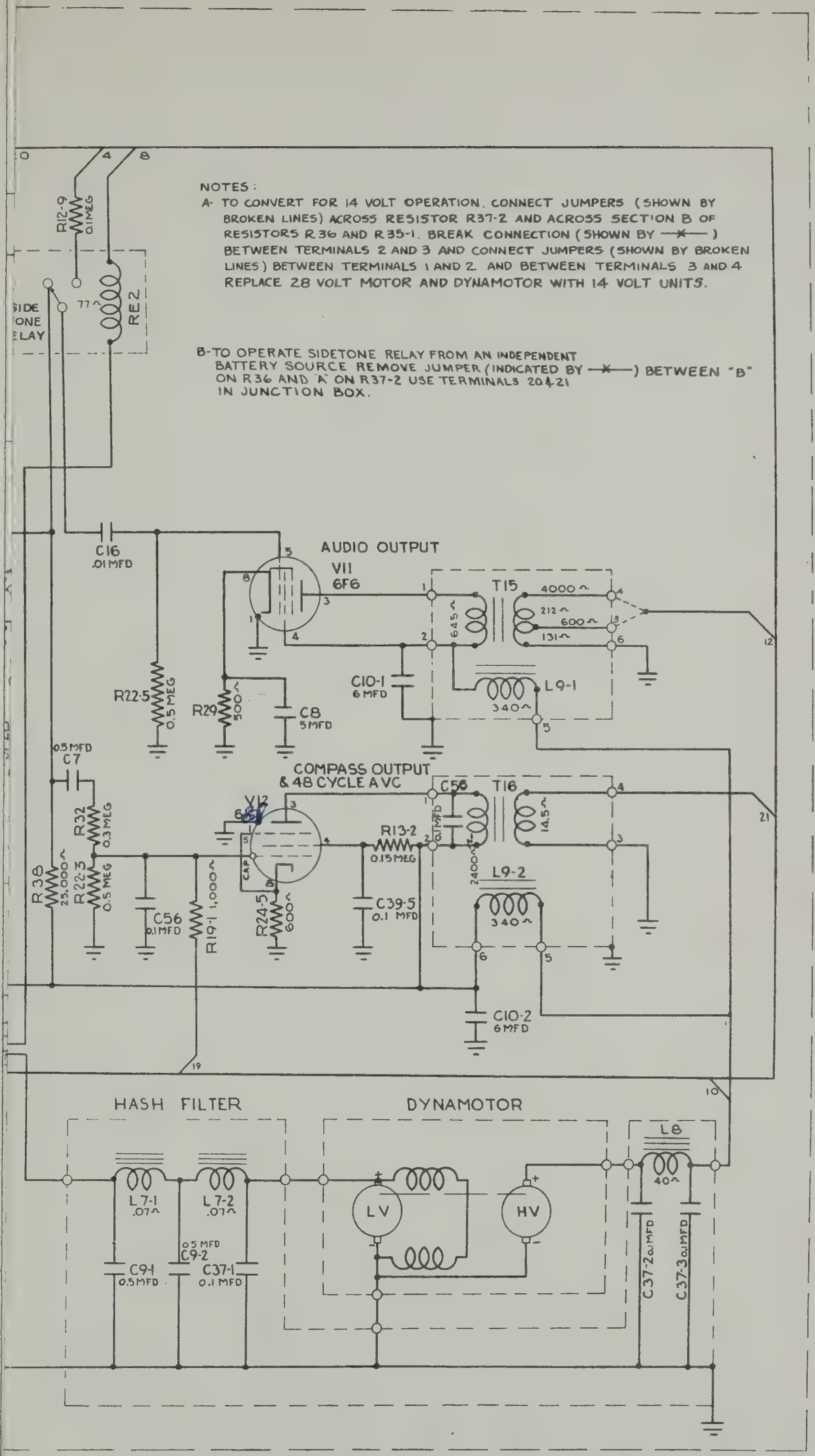


Figure 78 — Type MN-26Y Radio Compass, Schematic Circuit Diagram

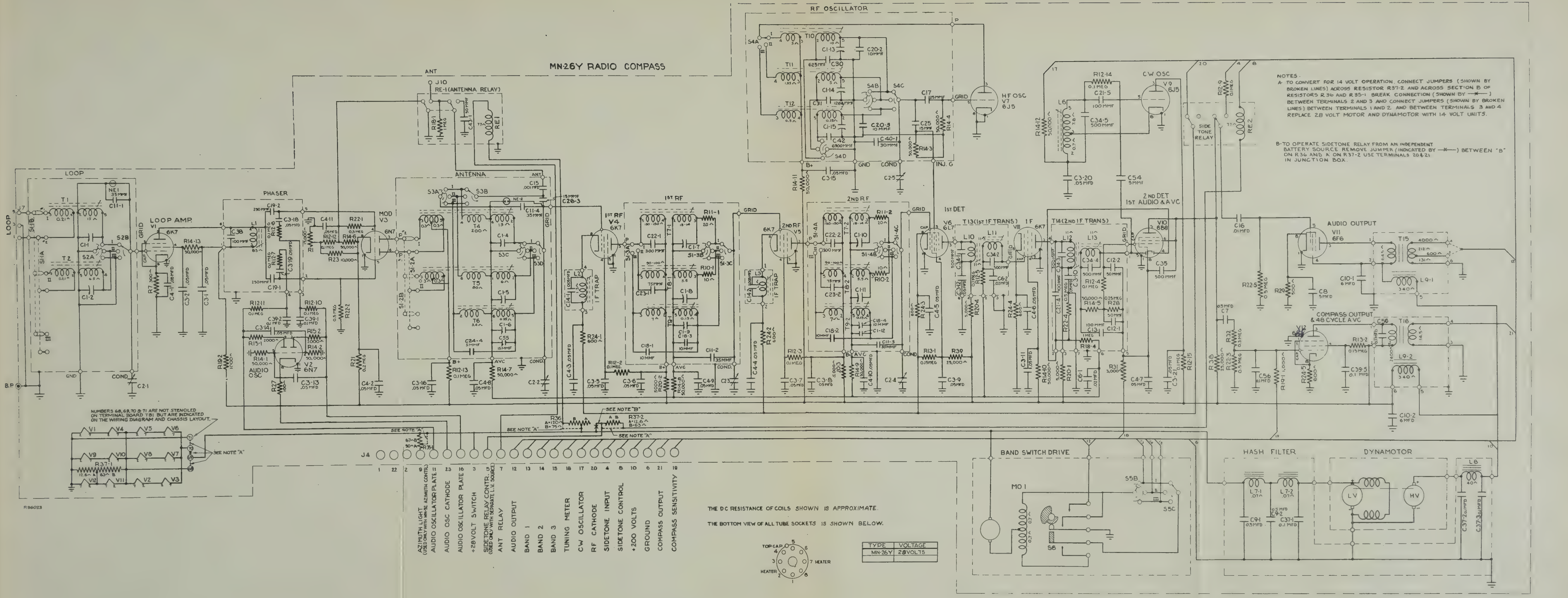
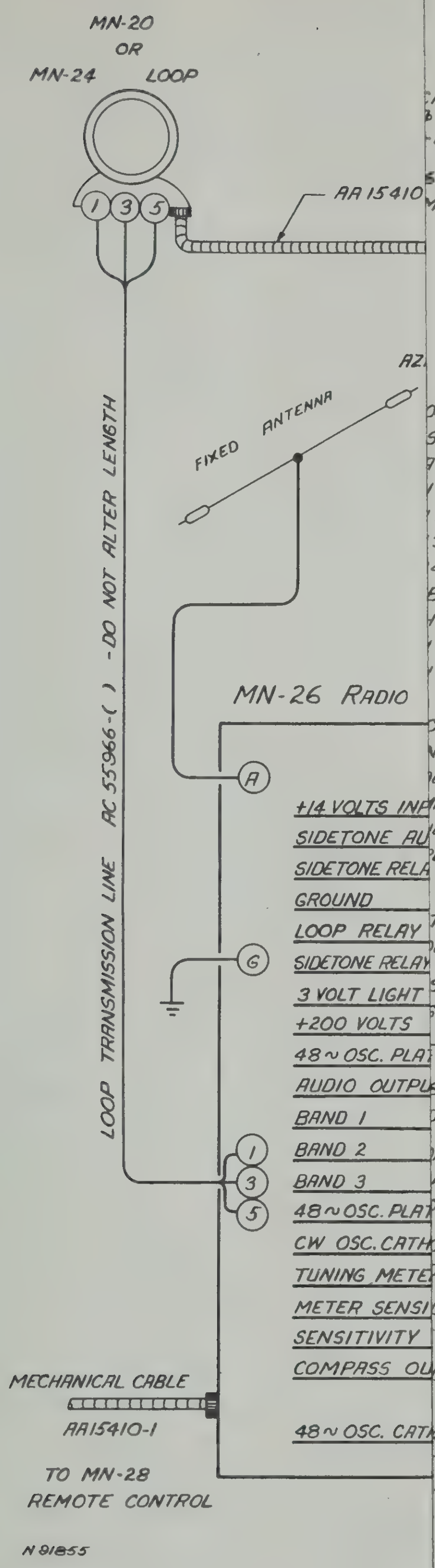


FIGURE 78 — TYPE MN-26Y RADIO COMPASS, SCHEMATIC CIRCUIT DIAGRAM



CAL CABLE
3
-1
5
MPASS

STANDARD MN-26 LEFT-RIGHT COMPASSES

FREQUENCY RANGE	150-325 325-695 695-1500	150-325 325-695 3400-7000	200-410 410-850 850-1750	200-410 410-850 3400-7000
14 VOLT RECEIVER	MN-26A		MN-26W*	
28 VOLT RECEIVER	MN-26C MN-26CA*	MN-26Y*		MN-26M
LOW IMP. REMOTE	MN-28C	MN-28Y*	MN-28X*	MN-28NA*
HIGH IMP. REMOTE	MN-28G			

* THESE UNITS HAVE NOT BEEN SUBMITTED FOR C.A.A. APPROVAL.

OS. ARE TO HAVE SUFFIXES AS DESIRED BY CUSTOMER. SUFFIXES ARE AS
S:
A-SUFFIXES OF CABLES 2, 3, 4, & 6:
1-HAS STRAIGHT CANNON PLUG } & PLAIN FERRULE WITH
2-HAS 90° CANNON PLUG } CONDUIT CLAMP & NUT
3-HAS STRAIGHT CANNON PLUG } & SHOULDER FERRULE
4-HAS 90° CANNON PLUG } & COUPLING NUT
B-SUFFIXES OF BATTERY & TUNING METER CABLES
1-HAS PLAIN FERRULE WITH CONDUIT CLAMP & NUT, BOTH ENDS.
2-HAS SHOULDER FERRULE & COUPLING NUT, BOTH ENDS.
3-HAS PLAIN FERRULE WITH CONDUIT CLAMP & NUT, ONE END AND
SHOULDER FERRULE & COUPLING, OTHER END.
C-REFERENCE
N FERRULE = BREEZE NO. 113-1-( )
UIT CLAMP = BREEZE NO. 78-( )
P NUT = BREEZE NO. 79-( )
LDER FERRULE = BREEZE NO. 111-( )
LING NUT = BREEZE NO. 4-( )

GROUP OF TERMINALS ARE CONNECTED TOGETHER, THE CIRCUIT
THE NUMBER OF THE INITIAL TERMINAL, THE OTHER NUMBERS IN
UP ARE DELETED FROM THE SYSTEM.

SINGLE SHIELDED CONDUCTOR
LASS INSULATED WIRE

LDING ON SHIELDED CONDUCTORS TO BE GROUNDED IN JUNCTION BOX.

8 VOLT SUPPLY IS USED ALL 14 VOLT DESIGNATIONS SHOULD BE CHANGED
O 28 VOLTS.

NLY ONE IN-4A L-R INDICATOR IS USED, FIELD LOAD ASSEMBLY, BENDIX
UMBER AA18824-1 MUST BE CONNECTED TO TERMINALS 15 & 14 IN MS-14B
N BOX.

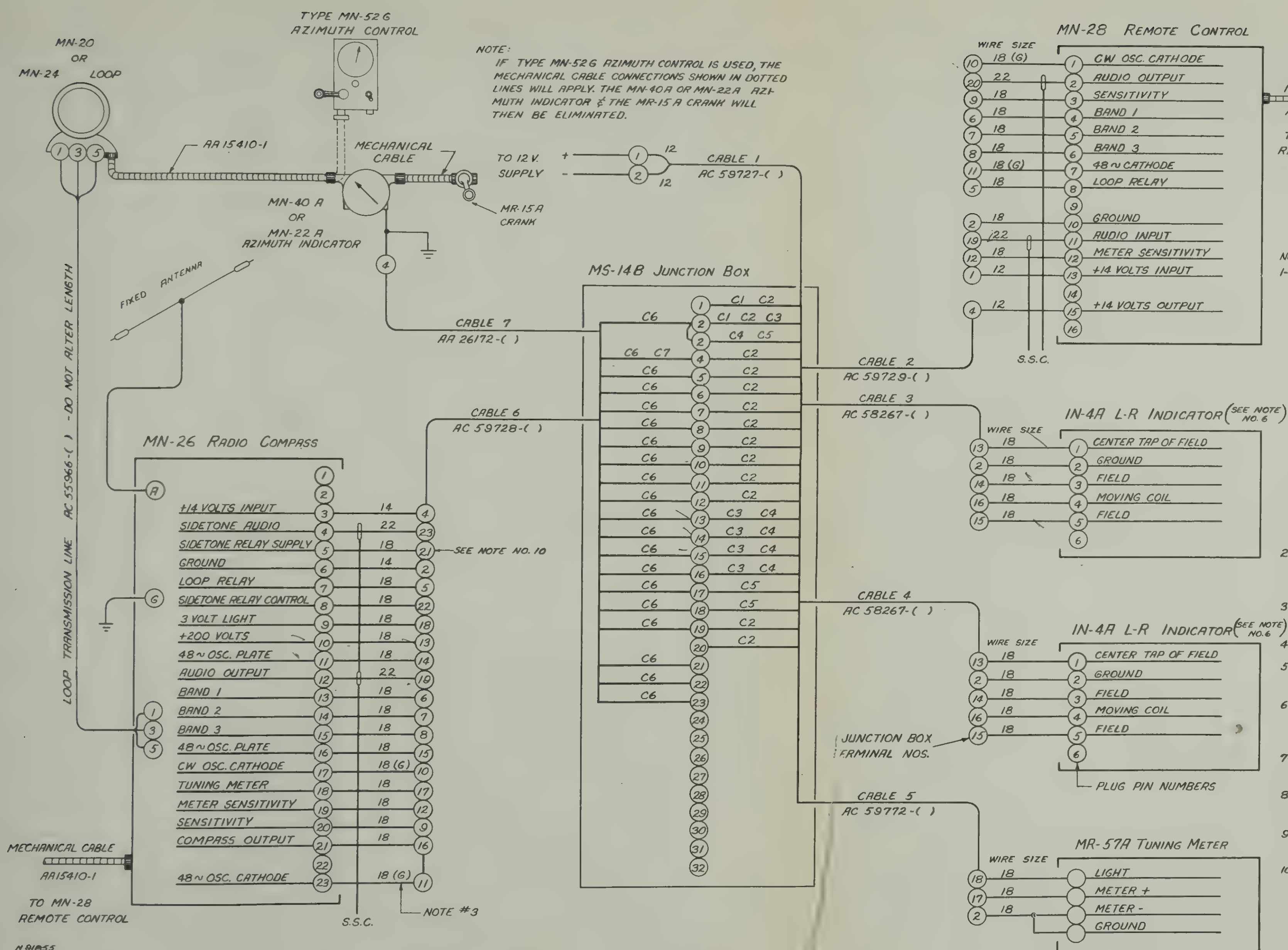
A FOR MARINE SERVICE. PRIMARY INPUT ARRANGED FOR POSITIVE
. EITHER MN-28C OR MN-28G MAY BE USED WITH MN-26CA.

UNITS MAY BE WIRED FOR EITHER LOW OR HIGH IMPEDANCE AUDIO
WITHOUT CHANGING TYPE NUMBER SUFFIX.

UNITS MAY BE USED IN EITHER 14 OR 28 VOLT SERVICE WITH
WIRING CHANGE.

RATE SIDETONE RELAY FROM AN INDEPENDENT BATTERY SOURCE
JUMPER BETWEEN "B" ON R36 AND "A" ON R37-2. USE TERMINALS
IN JUNCTION BOX. (SEE FIGS. 55, (NOTE C), 56, 57, 58 (NOTE B)).

FIGURE 79 — TYPICAL SYSTEM WIRING DIAGRAM



STANDARD MN-26 LEFT-RIGHT COMPASSES

FREQUENCY RANGE	150-325 325-695 695-1500	150-325 325-695 3400-7000	200-410 410-850 850-1750	200-410 410-850 3400-7000
14 VOLT RECEIVER	MN-26A		MN-26W*	
28 VOLT RECEIVER	MN-26C MN-26CA*	MN-26Y*		MN-26M
LOW IMP. REMOTE	MN-28C	MN-28Y*	MN-28X*	MN-28NA*
HIGH IMP. REMOTE	MN-28G			

* THESE UNITS HAVE NOT BEEN SUBMITTED FOR C.A.A. APPROVAL.

NOTES:

1- CABLE NOS. ARE TO HAVE SUFFIXES AS DESIRED BY CUSTOMER. SUFFIXES ARE AS FOLLOWS:
 NOTE A- SUFFIXES OF CABLES 2, 3, 4, & 6:
 DASH 1-HAS STRAIGHT CANNON PLUG } & PLAIN FERRULE WITH
 DASH 2-HAS 90° CANNON PLUG } CONDUIT CLAMP & NUT
 DASH 3-HAS STRAIGHT CANNON PLUG } & SHOULDER FERRULE
 DASH 4-HAS 90° CANNON PLUG } & COUPLING NUT
 NOTE B- SUFFIXES OF BATTERY & TUNING METER CABLES
 DASH 1-HAS PLAIN FERRULE WITH CONDUIT CLAMP & NUT, BOTH ENDS.
 DASH 2-HAS SHOULDER FERRULE & COUPLING NUT, BOTH ENDS.
 DASH 3-HAS PLAIN FERRULE WITH CONDUIT CLAMP & NUT, ONE END AND SHOULDER FERRULE & COUPLING, OTHER END.
 NOTE C- REFERENCE
 PLAIN FERRULE = BREEZE NO. 113-1-( )
 CONDUIT CLAMP = BREEZE NO. 78-( )
 CLAMP NUT = BREEZE NO. 79-( )
 SHOULDER FERRULE = BREEZE NO. 111-( )
 COUPLING NUT = BREEZE NO. 4-( )

2- WHEN A GROUP OF TERMINALS ARE CONNECTED TOGETHER, THE CIRCUIT BEARS THE NUMBER OF THE INITIAL TERMINAL, THE OTHER NUMBERS IN THE GROUP ARE DELETED FROM THE SYSTEM.

3- S.S.C. = SINGLE SHIELDED CONDUCTOR
 (G) = GLASS INSULATED WIRE

4- ALL SHIELDING ON SHIELDED CONDUCTORS TO BE GROUNDED IN JUNCTION BOX.

5- WHEN 28 VOLT SUPPLY IS USED ALL 14 VOLT DESIGNATIONS SHOULD BE CHANGED TO READ 28 VOLTS.

6- WHEN ONLY ONE IN-4A L-R INDICATOR IS USED, FIELD LOAD ASSEMBLY, BENDIX PART NUMBER AA18824-1 MUST BE CONNECTED TO TERMINALS 15 & 14 IN MS-14B JUNCTION BOX.

7- MN-26 CA FOR MARINE SERVICE. PRIMARY INPUT ARRANGED FOR POSITIVE GROUND. EITHER MN-28C OR MN-28G MAY BE USED WITH MN-26CA.

8- MN-26 UNITS MAY BE WIRED FOR EITHER LOW OR HIGH IMPEDANCE AUDIO OUTPUT WITHOUT CHANGING TYPE NUMBER SUFFIX.

9- MN-28 UNITS MAY BE USED IN EITHER 14 OR 28 VOLT SERVICE WITH SIMPLE WIRING CHANGE.

10- TO OPERATE SIDETONE RELAY FROM AN INDEPENDENT BATTERY SOURCE REMOVE JUMPER BETWEEN "B" ON R36 AND "A" ON R37-2. USE TERMINALS 20 & 21 IN JUNCTION BOX. (SEE FIGS. 55, (NOTE C), 56, 57, 58 (NOTE B)).

FIGURE 79 — TYPICAL SYSTEM WIRING DIAGRAM

STATION USED ____________________ FREQ. ____________________

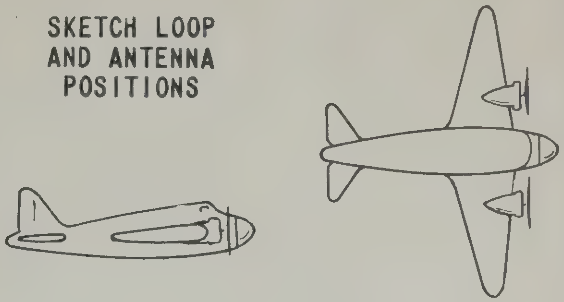
PLANE NO. ____________________ PILOT ____________________

RECORDER ____________________ DATE ____________________

REF. MARK QUAD. POSITION 0° ____ 90° ____ 180° ____ 270° ____

LOCATION ____________________

SKETCH LOOP AND ANTENNA POSITIONS



GYRO HEADING	PLANE TO RADIO STATION BEARING (TRUE RADIO BEARING)	OBSERVED RADIO BEARING (INDICATED ON MN-22A OR MN-40D)	BEARING CORRECTION (COLUMN 2 MINUS COLUMN 3)
COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
0	0		
15	345		
345	15		
30	330		
330	30		
180	180		
195	165		
165	195		
210	150		
150	210		
0	0		
45	315		
315	45		
60	300		
300	60		
180	180		
225	135		
135	225		
240	120		
120	240		
0	0		
75	285		
285	75		
90	270		
270	90		
180	180		
255	105		
105	255		
180	180		

CAM SCALE (OF MN-22A) OR INNER SCALE OF MN-40D	CAM CORRECTION FOR MN-22A (FROM CURVE)	OUTER SCALE OF MN-40D (COLUMN 5 PLUS COLUMN 6)
COLUMN 5	COLUMN 6	COLUMN 7
0		
15		
345		
30		
330		
45		
315		
60		
300		
75		
285		
90		
270		
105		
255		
120		
240		
135		
225		
150		
210		
165		
195		
180		

5876

Figure 80 — Quadrantal Error Data Sheet

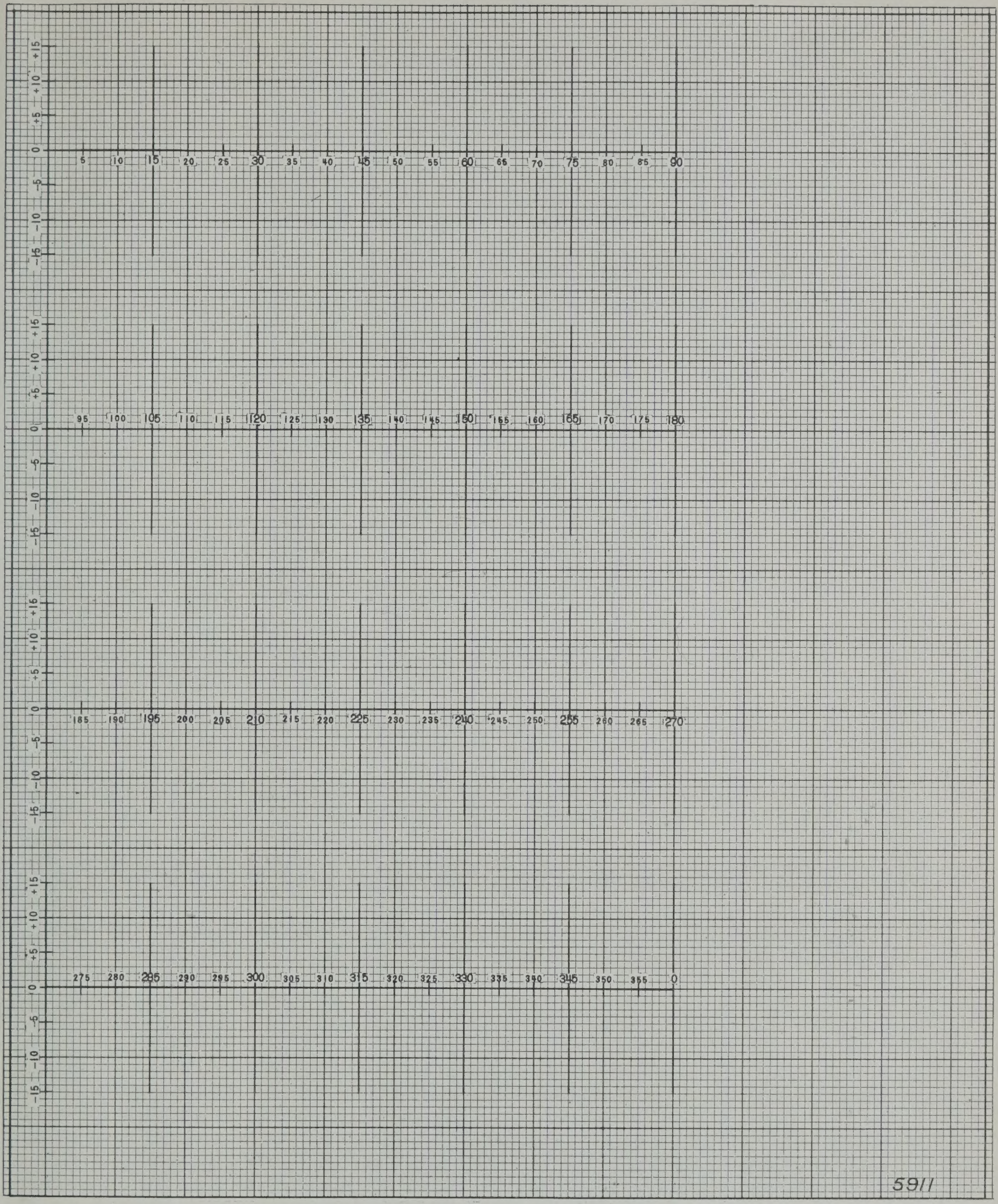


FIGURE 81 — QUADRANTAL ERROR CALIBRATION CURVE